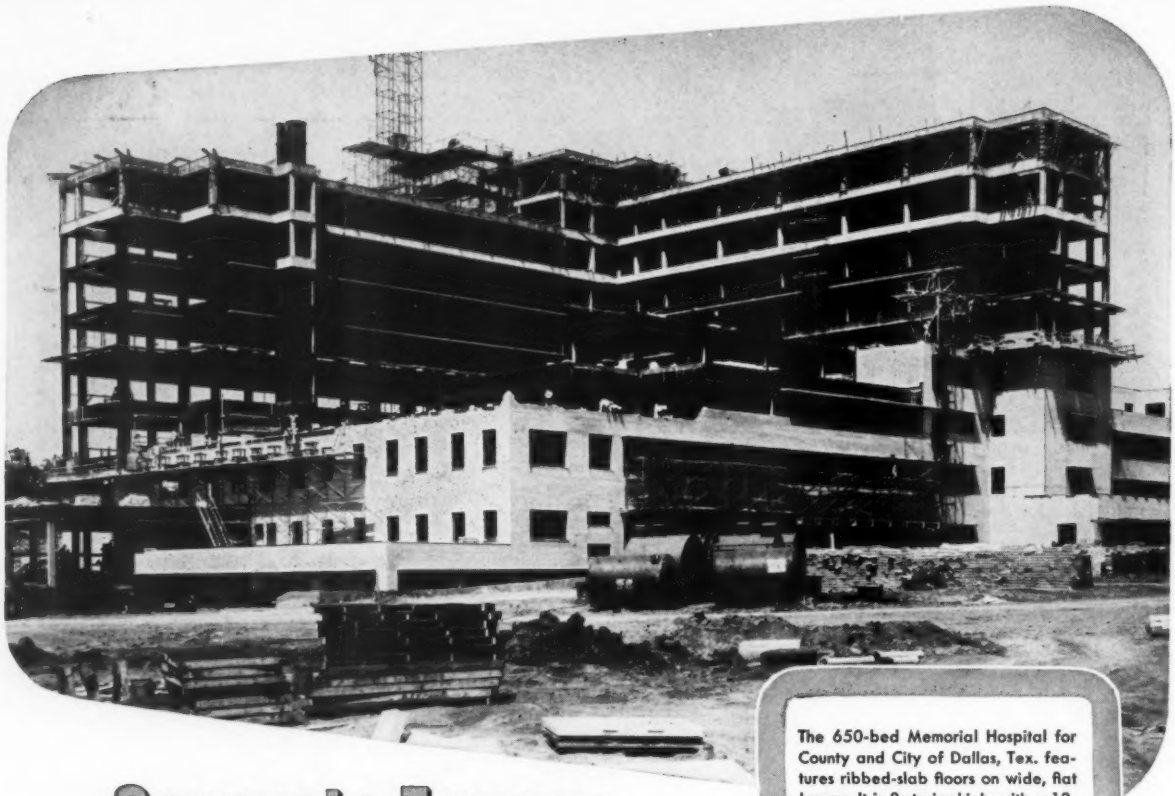
Midwest Engineer

WESTERN SOCIETY OF ENGINEERS FOUNDED 1869

LIGHTWEIGHT PASSENGER TRAINS—PAGE THREE

Vol. 8 SEPTEMBER, 1955 No. 4



The 650-bed Memorial Hospital for County and City of Dallas, Tex. features ribbed-slab floors on wide, flat beams. It is 8 stories high, with a 13-story center section. Architects: Dewitt and Swank; structural engineer: R. L. Rolfe; contractor: Robert E. McKee. All are from Dallas.

Aerial view below shows the hospital against Dallas skyline. Excavation in foreground is for the Southwestern Medical School Basic Science Building. It also is designed for reinforced concrete frame and floor construction.

Concrete Frames and Floors

. . . quality construction for modern hospitals

Architects and engineers can provide critically-needed hospitals faster and more economically if they design them for reinforced concrete frame and floor construction. That's why more and more hospitals are being built that way.

With reinforced concrete, frame and floor construction proceeds simultaneously. Walls can be finished and such facilities as plumbing, heating and electricity can be installed as the structural work advances. No need to wait until the entire frame is erected. So you save considerable time.

Moreover, competitive bids and cost analyses show you can save up to 40% on frame and floor costs with reinforced concrete. And durable, sturdy, firesafe concrete construction renders long years of service at little maintenance expense. The very practical result is ***low annual cost***—the only realistic measure of the cost of any building.

For more information about time-saving, economical concrete frame and floor construction write for free booklets, distributed only in U. S. and Canada. Address Dept. 8d-17.

PORTLAND CEMENT ASSOCIATION, 111 W. Washington St., Chicago 2, Ill.

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

MIDWEST ENGINEER
Published Monthly
BY
THE WESTERN
SOCIETY OF ENGINEERS
AT
84 EAST RANDOLPH STREET
CHICAGO 1, ILLINOIS

•

GENERAL AND EDITORIAL OFFICES
HEADQUARTERS OF
WESTERN SOCIETY OF ENGINEERS
84 E. RANDOLPH STREET
CHICAGO 1, ILLINOIS
TELEPHONE: RA NDOLPH 6-1736

•

•

Single Copy .....$ .50
Annual subscription 4.00
Foreign subscription..... 6.00

Entered as second-class matter at the post office at Chicago, Illinois under the Act of March 3, 1879.

Midwest Engineer

A Publication of the

WESTERN SOCIETY OF ENGINEERS

Serving the Engineering Profession

SEPTEMBER, 1955 Vol. 8, No. 4

CONTENTS

COVER STORY

The new "Aerotrain," spectacular new lightweight passenger train, shown posing at a special press preview at La Grange, Ill. The ten-coach 400-passenger train, made by the Electro-Motive Division of General Motors, weighs 50 per cent less than conventional trains. It has been a major attraction of the G. M. "Powerama" on Chicago's lakefront near Soldier Field.

a good advertising medium

FOR ALERT ADVERTISERS

Midwest Engineer

because . . .

- Circulation in America's industrial and residential heart.
- The direct path to specifying, purchasing, and industrial executives—those who say yes.
- Provides coverage in all engineered industries.
- Opens a live market area for machinery, fabricated products, industrial equipment, materials of construction, parts, tools, products and services.
- The mirror of the coordination of engineering and civic interests.
- Advertising rates are extremely low for coverage of this big market.

Western Society of Engineers

84 E. Randolph Street
Chicago 1, Illinois

Design for

Lightweight Passenger Trains

By William Van Der Sluys

For the past year, the railroad industry and the public has been bombarded with rumors, assertions and denials, concerning new lightweight passenger carrying equipment. The present state of affairs was most aptly described by the editors of Railway Age when, in their December 27th issue, it was stated "If you are confused as to who is buying what kind of lightweight train from whom—frankly, so are we! - - -."

Though unable to shed any light on the building-buying mystery, I hope to leave you with a fair idea of the circumstances motivating lightweight design, the objectives sought, and the several means by which such objectives are expected to be achieved.

Early Lightweight Trains

What you see in Figure 1 is not, as might be imagined, a 1955 model, ultra-lightweight train! It is, in fact, a picture of the Union Pacific Railroad's *City of Salina* built by Pullman-Standard just 21 years ago—the first so-called lightweight streamliner. This ghost of the '30's is ample proof of the fact that, to a degree, history is repeating itself and suggests that had the developments of that era been forcefully defended and aggressively carried forward, the nation's railroads might today be in a much stronger position with respect to the provision of passenger service.

Let's examine for a few moments some of the design features of the *City of Salina,* and keep them in mind when, later, we discuss present day concepts and objectives. You will, I think, be impressed by the startling degree of similarity between the events of yesterday and the probabilities of tomorrow.

This train, a three-car articulated unit delivered in February, 1934, consisted of a Motor-Mail-Baggage Car, a Trailer-Coach, and a Trailer-Coach-Buffet. Length of the two end cars was approximately 72'-0", with the center car being 59'-10". The ultra-streamlined cars were of all aluminum construction with a special cross sectional contour which might be described as generally elliptical in shape. Statistical comparison with cars of the then conventional design gives an idea of the degree of appearance change:

Height to Top of Roof.....10'-11½" vs. 13'-6"

Floor Height....2'-11-15/16" at Center and 3'-3-7/16" over trucks vs. 4'-3".

Width over Posts @ Widest Portion .....9'-0" vs. 10'-0".

In addition, certain innovations made the train quite different from anything then in service:

The bottom of each car was tightly sealed, with metal sheets covering all underframe members and underneath equipment.

A special mechanical air conditioning system was used—with the equipment located on one car, serving all three through connecting ducts. Air outlet was by duct at top center of the car, using side, slot-type air diffusers, and was returned through ducts located beneath the floor, one on each side of the car.

The heating system was of a forced hot air type. Heated air from oil burning, hot air generating units located on one car, was forced through connecting ducts to the other two cars and was fed into each car body by means of floor ducts on either side which were provided with grille openings.

Electric power for all cars was from an engine generator set located on the head end car.

Articulated trucks were of a special four-wheel design with outside roller bearings. The rear end truck was also of special design utilizing inside roller bearings.

Without going into the "whys and wherefores," some of which have become obscured by the passage of time, it is enough to say that essentially all innovations introduced with the *City of Salina* rapidly disappeared. Centralized systems for electrical power, heating and air conditioning were abandoned, cross-sec-

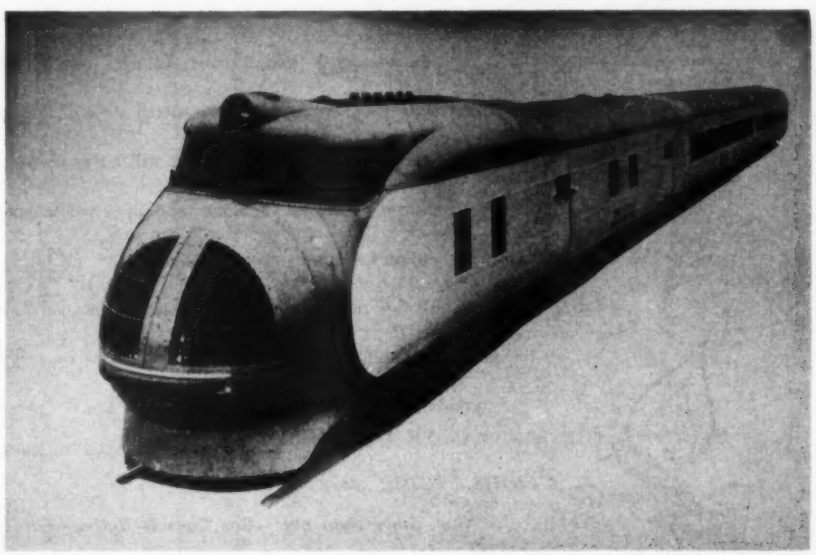


Figure 1. "City of Salina."

Mr. Van Der Sluys, manager of engineering design, Pullman-Standard Car Manufacturing Company, presented this talk before the Western Society of Engineers on January 18, 1955 at the society's headquarters in Chicago.

1855 • A CENTURY OF GAS SERVICE • 1955

The Lamplighter

My tea is nearly ready and the sun
has left the sky.
It's time to take the window to see
Leerie going by;
For every night at teatime and before
you take your seat,
With lantern and with ladder he
comes posting up the street.

Now Tom would be a driver and
Maria go to sea,
And my papa's a banker and as rich
as he can be;
But I, when I am stronger and can
choose what I'm to do,
O Leerie, I'll go round at night
and light the lamps with you!

For we are very lucky, with a lamp
before the door,
And Leerie stops to light it as he
lights so many more;
And O before you hurry by with
ladder and with light,
O Leerie, see a little child and
nod to him tonight!

"O Leerie, I'll Go Round at Night and Light the Lamps with You . . ."

Robert Louis Stevenson

Following the introduction of gas lighting in Ottawa, Illinois, in 1855, the era of the village lamplighter came to many of the towns now served by the Northern Illinois Gas Company. In those days many youngsters like the one Robert Louis Stevenson wrote about undoubtedly had childish admiration for the local "Leerie". Those, too, were the days of man-sized beards and of dainty bonnets, "sweep-the-floor" calicoes . . . days when the rumble of buckboards and carriages could be heard on the rutted streets. There also must have been lively conversation about the new "gas plant". "It probably will never be practical. Gas for street lighting, for home lighting. Impossible." It's been a hundred years now and those who envisioned the practical use of gas were right. The homemaker of today enjoys fast, clean, economical cooking with gas—speedy, low-cost water heating—silent trouble-free refrigeration and the many other convenient services gas performs. Today, the more than half a million homes and industries we serve in northern Illinois use gas in a myriad of ways never dreamed-of a century ago.

© N. I. GAS Co.

Penny Flame* *says:*

"Now, more than ever—Gas Does It Better—For Less."

NORTHERN ILLINOIS Gas COMPANY

tional and longitudinal dimensions returned to former standards and car weight was increased to approach that of pre-lightweight design. Perhaps the *City of Salina*, like Chrysler's "Airflow" automobile (built about the same time), was born before its time, yet served its purpose by providing a glimpse of the future.

Motivation

The intervening years have, of course, produced improvements in conventional passenger equipment. Comfort facilities have been vastly bettered, new materials and fabricating techniques have been adopted, car interiors have been made more appealing to the eye, etc.

Despite these changes, however, traffic volume, except for the war years, has steadily declined. Conversely, cost of owning, operating and maintaining the necessary facilities has increased at an even faster pace. Economic illness then, has focused attention of the railroad industry on the possible advantages of a completely new look in train design, aimed at attracting increased passenger traffic while at the same time, reducing costs.

The locomotive and car builders are now faced with the challenge of producing completely new trains which will herald a new era in railroad operations. There are five main objectives which must be met if this feat is to be accomplished.

1. Low Initial Cost

While most of the statements by railroad executives on this general subject are usually headlined as "light-weight," "ultra high speed" or some similar eye catcher, careful perusal usually brings out the fact that the primary objective is a major reduction in the cost of equipment. Present day coaches cost from $1,800.00 to over $3,000.00 per passenger seat, depending upon the service for which the cars are intended and how elaborate the interior treatment becomes. If this cost can be brought down to $700.00 to $900.00 per seat, profitable operation of such equipment comes within the realm of possibility. Weight reduction in itself does not necessarily mean cost reduction. For instance, structural weight can be reduced 20% to 30% by the use of aluminum, but the aluminum will cost four to five times as much as low alloy high-strength steel. Therefore, aluminum is only justified if its use permits other reductions, such as in the weight and cost of the running gear, or in reduction in operating costs. This leads into the second main objective:

2. Lower Operating Cost

This is the place where light weight can make a very definite saving for the railroads, since it has been estimated that it costs the railroads as much as $250.00 per year for every ton of extra passenger equipment they are forced to haul in normal service. In addition, the reduction in overall cross sectional area associated with most proposals for lightweight, low center of gravity trains will also mean a definite reduction in train resistance at high speed. Consequently, these new type trains can be operated with appreciably smaller locomotives, with appreciable savings in first costs and operating costs.

3. Lower Maintenance Costs

Since no railroad can afford increased maintenance costs, the builders of new equipment must be very careful to see to it that lightweight and low cost is not achieved by a sacrifice of reasonable strength or sturdiness of the components. There are many components in a car where reductions could lead to increased maintenance. For instance, one of the large airlines spends a quarter of a million dollars a year overhauling seats. While in attempting to find a much lighter seat, we will still want one which, if need be, can survive for the life of the car with no maintenance other than reupholstering it at infrequent periods. Also, it is important that new designs be kept free of "gadgets" which call for specialized maintenance and can be a never ending source of trouble.

Fortunately, it is possible to achieve lighter weight and also reduce maintenance by the elimination of certain items which have been a source of trouble in the past. An example of this approach would be the elimination of all direct-current motors with their attendant brush and commutator troubles.

4. Improved Riding Qualities

As most of you know who do much traveling by train, present day equipment varies from the exceptionally smooth ride where one hardly knows the car is moving to the rather poor ride which makes sleeping difficult, if not impossible. It is very important that new equipment meet at least the riding standards set by the best of present day cars. In addition, present equipment, with the soft springs which are essential to good riding qualities, rolls excessively on curves at high speed. For this reason, most of the new approaches are aimed at greatly reduced height of center of gravity. Any appreciable reduction in such height will greatly reduce the roll even with conventional springing, and greatly simplifies the problem of making the car self-banking. Partial solutions to this self-banking problem have been achieved in the past with conventional floor height equipment, but it now comes within the realm of possibility to build equipment in which the passenger will be as little conscious of turns as he is in an airplane where the vehicle is always banked at the correct angle for neutralization of lateral centrifugal force.

5. Increased Speed

Many of the articles which have appeared in the press on this subject of new trains have concentrated on predicted ultra high speeds. One was published very recently which mentioned casually that the train would travel at 150 MPH. This is not at all impossible. You may have read accounts in the paper a few month ago of a French train which had attained such a speed in test runs. However, even with greatly reduced frontal area, such speeds would not be economical. It is not possible for the railroads to compete with the airlines in this matter of top speeds, and any attempt to do so would be economic suicide. Even a moderate increase in top speed over present maximums of 90 to 100 MPH would mean a sacrifice of the gains made by weight and cross section reduction, since high speed demands plain brute power, and there is no magic means for eliminating this

(Continued on Page 18)

Three Keys to Solvency

By Howard E. Kroll

As a preliminary to discussing "Three Keys," let's first consider:

Five Major Business Functions

In the management of every business enterprise there are, I think, five major functions which must be performed with reasonable success if the enterprise is to continue in existence and to prosper. First, there is the buying function whose job is to provide raw materials at the lowest possible price, in the right quantities, in the right qualities, in the right places and at the proper time. Certainly we will agree that that is an important function which, if not performed properly, can wreck a company.

Second, there is the production function whose job it is to manufacture the goods with the greatest possible efficiency, in the right quantities, of the right quality and at the right time. Failure to perform this function can likewise lead to disaster, and I am sure that we will all agree that this is a vitally important phase.

Third, there is the sales function whose job it is to sell the product in sufficient amounts to cover the overhead and, if possible, to provide a profit and, in some lines, to sell at the right time so as to avoid missing seasonal demands. This, too, is a vital function whose importance we shall all readily recognize.

Fourth, there is the administrative function whose job it is to coordinate the other four so that the organization as a whole will operate as a unit toward the major objective of the enterprise, namely, earning a profit. I don't know too much about this, but as I understand it, the start is usually made with the sales estimate, from which it is possible to plan production schedules and from the production schedules to plan buying schedules. The administrative department watches developments closely and as the sales program develops better or worse than anticipated, adjustments are made in production and buying so as to keep all operations well balanced and coordinated. Certainly, this likewise is a vitally important function.

Finally, as a fifth major function, there is the job of handling the finances. At first thought it may seem that the primary job of the financial department of the enterprise is to see to it that money is available to meet operating expenses and payrolls punctually as they mature, and this is superficially true. More fundamentally, however, the job of the financial department is to see to it that the basic financial policies of the enterprise are so sound that the ability to meet obligations punctually at maturity will follow as a logical, inevitable result.

Three Key Financial Policies

What are these basic financial policies? In my opinion there are only three, provided you will agree that keeping inventories and receivables turning actively is simply a matter of efficient management and not necessarily a matter of basic policy. If you do not agree to this last, I shall make no issue of it because you may well be right in thinking that keeping inventories and receivables turning actively is also a matter of fundamental policy. It certainly is important.

Relationship of Fixed Assets to Net Worth — Key Number 1

The first of the three fundamentals, which in my opinion are most important, is concerned with the fixed assets and may be phrased like this: "A company's investment in net fixed assets should be in proper relationship to its tangible net worth." What should this relationship be? There is no one answer to this question. Near one extreme are the finance companies and wholesalers of dry goods which seldom have any need of investing more than 5% or 10% of their tangible net worth in net fixed assets. At the other extreme are the public utilities whose very existence depends upon having large plant investments and which frequently invest as much as 300% of their tangible net worth in plant assets. But if I may take what I shall call an "average" concern, and it is amazing to see how many different lines of business tend to fall into this category of "average" concerns, I would say that a company should try to limit its investment in net fixed assets to somewhere around 30% or 35% and not over 50% of its tangible net worth. As a matter of fact, in many lines, particularly retail, the typical figure runs considerably lower than 30%.

The violation of this fundamental occurs when a company invests too large a proportion of its resources in fixed assets. When it does this, it tends to absorb liquid capital which instead ought to be reserved for financing the day to day operations of the business. In addition, an excessive investment in fixed assets tends to build up productive capacity and its attendant expenses for insurance, maintenance, and "watchmen" and it raises the break-even point to a level that is not always easily maintained if sales drop off. Now I am going to leave the discussion of the first principle for a few minutes and shall come back to it later after I discuss the second.

Relationship of Working Capital to Sales — Key Number 2

The second major fundamental has to do with working capital and can be expressed something like this. "The working capital of an enterprise should be in proper proportion to its sales." What does that mean? The answer can be provided very simply with a couple of somewhat obvious statements. If a business man has $5,000 of working capital, he may find himself able to finance quite comfortably a little butcher shop, but he would be silly to try with that modest capital to finance the operations of a large metropolitan department store. For the latter purpose he might need $10,000,000. But with only $10,000,000 he would be silly to try to finance the operations of General Motors. To finance General Motors comfortably, working capital of around $1,000,000,000 is necessary. In other words, there is a relationship between the amount of working capital available to a business concern and the amount of business that it can safely

Mr. Kroll, regional specialized report manager, Dun & Bradstreet, Inc., presented this address before the Western Society of Engineers at the Society's headquarters in Chicago on January 10, 1955.

transact with that working capital.

What should that relationship be? Again there is no one categorical answer. Near one extreme are the wholesalers of tobacco products and of produce, which have a very rapid turnover of inventories, which collect their receivables promptly on short terms, and which quite frequently show an ability to handle comfortably an annual sales volume equivalent to $20, and frequently much more, for every dollar of working capital. Near the other extreme are such lines of business as the distillers and cigarette manufacturers, which must age their inventories for considerable periods and which, therefore, frequently find themselves able to handle only $2 or $3 of annual sales for each dollar of working capital. But, again, if I may take what I will call an "average" company, then I might say that for many lines of industry, particularly manufacturing and wholesaling, the typical relationship is that the annual sales run around $3 to $6 for each dollar of working capital.

The violation of this second major fundamental is found when a company tries to transact a larger sales volume than its working capital will comfortably support. When sales increase, it is almost always necessary to carry larger inventories and receivables. It becomes necessary to have heavier forward commitments. It generally takes more employees to sell the output, to manufacture it, and to handle all the internal details of running the business. In other words, all the purposes for which working capital is necessary are intensified, and unless working capital is increased in line with the sales, the internal stresses become greater and the company becomes vulnerable to any unexpected unfavorable developments.

When a company transacts too large a volume for its working capital, in other words, when this relationship of annual sales to working capital becomes too high, we credit men call the condition "overtrading." It seems to me that "overtrading" is very much like driving an automobile too fast. Let's say that a speed of 45 miles an hour on a straight open road is a safe rate at which to drive. At that speed the driver has adequately complete control over his car, can slacken his speed or change his direction quickly enough to avoid an accident. But if he increases his speed to 75 miles an hour he may still have adequate control as long as nothing unfavorable happens. If, however, another car suddenly appears directly ahead from a side road, the first driver may not have time to slacken his speed or to change his direction quickly enough to avoid a serious accident.

So it is with the business concern which overtrades. The management may have complete control over its operations, it may find merchandise coming in steadily, may find manufacturing and selling proceeding smoothly and collections coming in promptly so that there is money to meet obligations punctually at they mature. But some sudden drop in demand, the unexpected failure of an important customer, or inability to obtain raw materials smoothly may so disrupt operations that cash resources are quickly depleted, and the resources to meet maturing obligations for sup-

plies and operating expenses will be dissipated and failure can quickly result.

Danger of Overexpanding Fixed Assets

Now I want to return to the first fundamental which, you will recall, we laid aside temporarily. I want to come back to it because in my opinion these first two fundamentals are frequently so closely related. So many times I have seen, and I am sure you have, companies which have built up their plant investments in order to be able to handle a volume which seemed readily available and in order to earn the larger profits which were expected to follow the expanded sales volume. I think that in most of these cases the managements have been so absorbed in the potentialities for larger profits that they have considered only the effects upon their income accounts and have not considered the effects on their balance sheets. When the plant expansion was completed, they found that their working capital had been too greatly absorbed in fixed assets. As a result, they found themselves with less working capital now available with which to finance a larger volume, and an overtrading condition then resulted. Sometimes such a situation can be worked out satisfactorily but too often it results in failure, and I submit that as a matter of fundamental financial policy it is unwise to overexpand in fixed assets, both because that can be expensive in itself and because it absorbs working capital and leads to an overtrading position from which disaster can result.

Perhaps one or two illustrations will show the working out of these first two fundamental principles. Years ago a young man immigrated to this country. He was a thrifty, hard working and capable young man, and after working in a dry goods store for a year or two, he saved enough money to open his own store. He showed excellent merchandising ability, served his customers well, and prospered. It wasn't long before he had earned and saved enough money to open a second store, and as the years went by he kept adding to his chain. Year by year, sales increased steadily as the enterprise grew and the earnings record was a consistently favorable one. With his absorption in merchandising and its effects on the income account, he failed to note that as new stores were opened, it became necessary to buy more display cases, more cash registers, and more of all the fixtures and equipment that it takes to run dry goods stores. He did not realize that his investment in fixed assets was steadily increasing from 30% to 40%, to 50% and finally, when the situation came to my attention, to 60% of the tangible net worth. At the latter point working capital had been so absorbed that with the larger volume from additional stores the company was in an extended overtrading position with all available bank lines in use and with trade payments running slow nevertheless. At that time I had an opportunity to talk with the owner, and I learned that he had no conception of the financial condition of his enterprise. He was so absorbed in merchandising and making money that he had paid no attention to his balance sheet at all, and he did not realize that if the trend then in existence continued just a short while longer, there would be serious danger of bankruptcy. Fortunately, I was able to make him realize what the condition was and he immediately changed his expansion policy to one of contraction in fixed assets, and the result was that what was a badly extended position began to show steady strengthening. Today that concern is still prospering but it is also financially sound and the owner sleeps nights.

Case Histories of Overtrading

But an overtrading condition can exist by itself without excessive fixed assets. There was another company which started operations in 1935 with a beginning capital of $10,000. It manufactured a consumer product which, with certain basic improvements, found a strong consumer response. The manufacture of this product was largely an assembly operation so that the investment in fixed assets consisted only of work benches and some relatively inexpensive tools. Because of the strong consumer response, sales in the first year were about $100,000 on which a profit of $25,000 was earned to increase the net worth to $35,000.

1936 was a repetition of the 1935

(Continued on Page 25)

Lithium-the-Light Invades Industry

Lithium, the lightest metal in the world, is having a heavy impact on American industry.

Discovered in 1817 in Sweden, lithium saw almost no use until the 1880's when lithium hydroxide was employed in the manufacture of Edison batteries, a type still used in mine locomotives and other similar cases.

During World War I lithium became a tool of war with the use of lithium hydroxide in submarine batteries, and in World War II it performed a mission of mercy with the use of lithium hydride as part of aircraft ditching equipment. Lithium hydride is reacted with sea water to form hydrogen for balloons to mark the location of a downed airplane.

During the past decade, practical uses for lithium compounds have increased so fast that it probably will be several years before industry's huge appetite for the materials can be satisfied.

One of the major producers of lithium chemicals is American Potash & Chemical Corporation which started producing crude lithium concentrates at its main plant at Trona, Calif., in 1938. Since 1951 these concentrates have been upgraded to lithium carbonate for use by industry.

Although lithium ores are found in many parts of the world, North America is believed to rank first in deposits. Africa is second, while South America, Europe, Australia and Asia also have sizable deposits.

American Potash & Chemical Corporation is active in producing lithium in the two richest areas, in the United States and Africa.

In addition to its lithium carbonate production at Trona, the company has a substantial interest in a large lithium deposit located at Bikita, Southern Rhodesia, Africa. The Bikita deposit is believed to be the world's largest high-grade deposit of lithium-bearing lepidolite.

Companies participating in the Bikita development are currently investing over $2,000,000 in the project.

Latest step in American Potash's lithium plans is the formation of a new company, American Lithium Chemicals, Inc., for which a $6,600,000 production plant is under construction near San Antonio, Texas, to produce lithium hydroxide. The plant will be completed, according to schedule late this year.

Stockpiling of Bikita lithium ore was begun in June, with the first shipment of nearly 11,000 tons. A continuing supply of lepidolite will be shipped from Bikita to San Antonio for processing into lithium hydroxide which will be distributed to lithium users.

At present, the most widespread industrial use of lithium is in carbonate form for porcelain enamel coatings and ceramic glazes. In porcelain enamels such as those used on pans and bathtubs, it results in a lower melting point of the enamel frits, which flow more easily and permit the use of cheaper grades of steel. In ceramics, lithium carbonate produces a free-flowing glaze that can be fired at lower temperatures and in a shorter time, thus offering valuable savings in production cost.

Another major use is in all-weather greases which can be applied, for example, to a vehicle in the Arctic region and

then transferred immediately to the tropics with equally efficient operation. Because of this, it is believed that most automotive greases will contain lithium within a few years.

In air-conditioning, it is used as a dehumidifying agent, for lithium chloride solution absorbs large amounts of moisture from the air, which are released when the solution is heated, putting the material in good "working order" once more.

Lithium chemicals are finding numerous other applications vital to our industrial well-being. In the medical field, for example, it is employed in the production of a synthetic vitamin A, while lithium stearate also has entered the cosmetic field in the form of face creams.

American Potash selected San Antonio as the site for the new lithium chemicals manufacturing plant after a search of areas both in Africa and the United States. Three main factors determined the site: availability of suitable limestone, adequate good water and an economical supply of fuel.

In the search, numerous locations were examined in Pennsylvania, Missouri, Southern California and Texas, as well as Africa. An interesting note in connection with limestone is that oyster shells were considered as a source but then were rejected because of a high sulfate content unfavorable to processing.

Finally, approximately 200 acres of land about seven miles northeast of San Antonio were selected.

Several excellent limestone quarries are located in the area, an adequate supply of good water is available at about 600 feet deep, and ample fuel is available in the form of natural gas from Texas oil and gas fields.

In the process, lepidolite containing between three and four per cent lithium oxide is combined with limestone. The materials are fine-ground, mixed and then roasted in a rotary kiln.

Soluble lithium and potassium salts set free by the roasting process are leached out of the roasted material by water. From the resulting solution, lithium hydroxide is recovered by concentration and evaporation.

Although American Potash & Chemical Corporation's lithium production is substantial at present, the San Antonio plant production will make the company one of the largest producers of lithium chemicals in the world.

Only One Mile Long But Two Miles High

A mile-long extra-high voltage electric transmission test line, located 10,300 feet above sea level, will be constructed by the Public Service Company of Colorado at its Leadville Substation. Construction of the test line will be started this summer by Public Service Company crews, and first tests are scheduled for the spring of 1956.

In making the announcement, M. M. Koch, vice-president in charge of electric operations for the company, said that, "the test line is being built to determine operating conditions including corona losses and radio influence at high altitudes. The data will be compared with that already obtained at low altitudes, so that suitable designs for high voltage lines at altitudes from 5,000 to 12,000 feet can be developed."

The tests will be made under a wide variety of weather conditions on both single and bundled conductors of various sizes throughout a range of extra-high voltage approaching 500,000 volts, Koch added. Both wood-pole and steel-tower construction will be used.

Several electrical equipment manufacturers are cooperating in the tests. Westinghouse Electric Corporation will supply transformers, and instrumentation for corona-loss and radio influence measurements on the new test line as well as providing lightning arresters, and disconnect and grounding switches for the installation. Aluminum Company of America will supply conductor cable for the tests. Substation and line structural equipment, line hardware, and insulators will be supplied by U. S. Steel's American Bridge Division, Hughes Brothers, Inc., Malleable Iron Fittings Company, and Ohio Brass Company.

Engineers from Public Service Company and Westinghouse Electric Corporation will perform the tests, recording data, and evaluating results in cooperation with the engineering departments of the other manufacturers.

ASME Celebrates 75th Jubilee

The American Society of Mechanical Engineers' Diamond Jubilee Annual Meeting will be held this year in Chicago at the Congress, Conrad Hilton and Sheraton-Blackstone Hotels from Nov. 13-18, according to an announcement from Society headquarters. Special features commemorating ASME's 75th anniversary have been planned for the six-day event.

ASME conferees will hear and discuss more than 300 technical papers at 110 sessions covering a variety of subjects: aviation, applied mechanics, management, materials handling, oil and gas power, fuels, safety hydraulics, metals engineering, heat transfer, process industries, production engineering, machine design, petroleum, nuclear engineering, railroad, power, textile gas turbine power, wood industries, rubber and plastics and instruments and regulators.

The American Rocket Society, an affiliate of ASME, and celebrating its 25th anniversary this year, is holding its sessions within the ASME meeting.

The Chicago Section of ASME will be hosts to their fellow-Society members and have arranged an interesting and diversified program of events for them. A dinner and pageant highlighting ASME milestones from 1880 to the present is listed for Tuesday evening. At a special Honors Luncheon on Thursday, the five major joint engineering awards will be conferred. These are: The Hoover Medal to Charles F. Kettering; John Fritz Medal to Philip Sporn; Elmer A. Sperry Award to William F. Gibbs; Henry L. Gantt Memorial Medal to Walker L. Cisler, and the Daniel Guggenheim Medal—the recipient to be announced.

The Society's diamond jubilee banquet on Thursday evening will highlight the week-long festivities, to be followed by closing sessions on Friday. Retiring president Mr. David W. R. Morgan will be the toastmaster at the banquet.

Sidelighting the 75th anniversary celebration will be the "Exposition of Power and Mechanical Engineering" at the Chicago Coliseum from Nov. 14-18. Under the auspices of ASME, the exposition will feature displays showing the newest developments in equipment power generation and distribution, automatic control, mechanical power transmission and utilization . . . maintenance as well as production equipment designed to lower operating costs and reduce maintenance. A new timely section on Atomic Power will also be featured.

New Film Released

"Engineering — A Career for Tomorrow" is the title of a new 16 mm film designed to promote interest in engineering education among high school students. Produced by Eta Kappa Nu association, in co-operation with the University of Illinois and industry, it portrays various phases of engineering through on-the-job scenes of engineers at work on typical problems in the field.

In a preview at the recent meeting of the ASEE, many of those who saw the picture gave it an enthusiastic reception as a means for encouraging young people to choose engineering as a profession.

The film is 16 mm with sound, is 900 feet long, and the running time is 28 minutes. Both black and white and color prints are available at cost, and inquiries are invited from universities, high schools, industrial and other organizations.

Distribution of the film is handled by the Chicago Alumni chapter of Eta

Kappa Nu, as a non-profit public service to the engineering profession. Information may be obtained from Mr. J. E. Farley, Illinois Bell Telephone Co., Room 301, 208 W. Washington St., Chicago, 6, Illinois.

The Atom Light of United States City

Electricity, produced from nuclear energy, has been used to light and power a town in the United States.

Arco, Idaho, became the first community in the Nation to receive its entire supply of power from a nuclear source when, on July 17, 1955, electricity produced in an experimental nuclear power plant operated by Argonne National Laboratory at the U. S. Atomic Energy Commission's National Reactor Testing Station, twenty miles from Arco, was fed into transmission lines supplying the small town.

When the reactor power was cut in, utility lines supplying conventional power to Arco from the Utah Power and Light Company, were disconnected. The entire community of 1,200 inhabitants then depended solely on nuclear power for more than one hour.

Although the transmission of electricity from the nuclear power plant to Arco was, by prior arrangement, discontinued after the demonstration had been completed, the generation of electricity at the testing station site was continued.

A motion picture record of the demonstration was presented to the United Nations on Aug. 12 at the International Conference on Peaceful Uses of Atomic Energy, at Geneva, Switzerland.

The experimental nuclear power plant, known as "Borax," short for Boiling Reactor Experiment," was the subject of a major technical paper presented to the Conference August 9 by Dr. Walter H. Zinn, Director of Argonne National Laboratory. The plant, which generates more than 2,000 kilowatts of electricity, was designed and constructed by the Laboratory. Harold V. Lichtenberger, who is a U. S. technical advisor at Geneva, is director of the Laboratory's activities at the testing station.

The reactor for the nuclear power plant has been under development by the Laboratory since 1953. An experimental facility for conducting studies of a reactor of this type was constructed at the testing station site in the summer of 1953 and tests on safety and steady state operating characteristics were conducted. The tests were sufficiently encouraging so that additional studies were made in the summer of 1954.

Experience gained during the operation of this reactor warranted the addition of a turbo-generator so that the steam being produced could be converted into a more usable form of energy. This generation plant was placed into operation on June 28, 1955, and the production of electricity is continuing on a routine basis.

The reactor consists of a pressure vessel containing an assemblage of enriched uranium-bearing plates submerged in water, plus a number of neutron-absorbing control rods. The water circulates through the reactor core by natural convection. Steam, produced by the heat created by the fissioning of uranium atoms, is conducted to the 3,500 kilowatt turbo-generator, located in a nearby building.

The simplicity of construction, ease of operation, low cost, and high degree of safety suggest the possibility that this type of small power plant may be suitable for use in remote areas or in conjunction with mining or manufacturing operations.

Beware of Shallows

Let all Men know thee, but no man know thee thoroughly: Men freely ford that see the shallows.

—Poor Richard's Almanack

CRERAR LIBRARY
News and Notes

The Library normally keeps statistics only on the number of calls for volumes from the stacks each month. This is a very gross measure of use; a detailed analysis is a time consuming procedure possible only on a project basis. To acquire a variety of data for administrative use, a project was undertaken this summer to prepare a detailed analysis for book calls for the month of March, 1955. This involved an analysis of 12,414 call slips in a variety of ways with some very interesting as well as significant results.

Of the total use of the book collection, 72.9% was from subject areas of primary interest to the Technology Department; 27.1% was from subject areas of primary interest to the Medical Department. In use of collections of primary interest to the Technology Department, it is interesting to note the distribution of use in various subjects:

All branches of Engineering except Chemical	26.3%
Chemistry and Chemical Technology	16.2%
Natural History	7.1%
Mathematics, Astronomy and Physics	6.8%
Agriculture	2.1%
Miscellaneous (including general periodicals)	14.4%

One surprising statistic emerged from the analysis of book calls as between monographic works and periodical or serial publications, namely that, contrary to our expectations, books are much more heavily used in the medical department than periodicals. Of total use in both departments, 41.9% represented monographs, 58.1% periodicals; in the Technology Department, the difference was even greater with 34.3% of use in monographs and 65.7% of use in periodicals. In the medical department, however, the balance was as follows: 60.8% use of monographs and only 39.2% use of periodicals. This can be partially accounted for but only partially by the fact that there are several hundred recently bound volumes of most heavily used periodical titles on the open shelves of the Medical Department, a circumstance which is not true in the Technology Department because of lack of shelf space.

Distribution of use by date of publication has an important bearing on the selection of volumes to be shelved in the Midwest Inter-Library Center. Until the present time we have limited our deposits for the most part to material published prior to 1900. The results of this analysis not only support our present practice but suggest in some subject areas that books of a more recent date may be deposited. For example, it was found that 94.6% of all book calls represented publications issued in 1900 to date and that 80% of all calls represented publications issued in 1930 to date.

Northwestern Unit Writes History of Oil

A two-volume history of the American oil industry that is expected to be the most complete and authoritative ever published is being written by the Center for Social Research of Northwestern University under a grant provided by the American Petroleum Institute.

The University and the Institute announced jointly on Aug. 12 that preliminary work on the project already is under way. Publication is scheduled for 1959, the centennial anniversary of the petroleum industry in the United States.

Chief author and director of the project is Dr. Harold F. Williamson, profes-

sor of economics and chairman of Northwestern's committee on business history, under whose auspices the study is being made. Dr. Williamson has published several other industrial histories, and is editor of a collaborative economic history of the U. S., *The Growth of the American Economy*.

Associate director and co-author is Arnold R. Daum, a historian with 15 years' experience in the oil business.

Arrangements have been made with ranking business and economic historians and leaders in petroleum and related fields for the exchange of manuscripts, bibliographical notes, and other information.

"We think this will be a valuable and unusual history," Dr. Williamson said. "Not only is it the first attempt to survey the entire industry, but it is being carried out under an agreement that incorporates the University's standards of objective research and writing."

Co-author Daum added: "Our main task is to select from a voluminous literature, and to interpret from this material in relationship to American society the epic growth of the petroleum industry."

Frank M. Porter, president of the American Petroleum Institute, said:

"This will be the first complete history of oil's dynamic growth and development. It will encompass 100 years of civilization, a period of social, human, technological, and economic advancement without precedent.

"Considerable study and discussion preceded not only the decision to sponsor such a history, but also selection of Northwestern University to undertake this task. We feel that Northwestern is eminently qualified to provide the industry and the academic world with an exceptional history, wide in scope and significant in scholarly interpretation."

In addition to the regular staff, an academic advisory staff is composed of Prof. E. T. Grether, dean of the school of business administration, University of California; Dr. Thomas C. Cochran, professor of American Civilization, University of Pennsylvania, and Professor G. Heberton Evans, chairman of the department of economics, Johns Hopkins University.

The API History Committee, composed of members of its board of directors, is administering the grant on behalf of the industry. It will make periodic reviews of programs, provide technical advice to the authors, and establish channels to sources of information.

Dr. John W. Frey, of Washington, D. C., retired director of the API division of marketing, is assisting the committee in its staff work and maintenance of liaison with the project.

Diamond to Highlight Convention of ASTE's

A symposium on industrial diamonds will be one of the highlights of the American Society of Tool Engineers national convention and industrial exposition at Chicago's International Amphitheatre, March 19-23, 1956.

The symposium will be co-sponsored by the ASTE and Armour Research Foundation of Illinois Institute of Technology, and will be held March 19-21.

Technical co-chairmen are Harold C. Miller, assistant manager of Armour Research Foundation's physics research department, and Col. Leslie Fletcher, ASTE research director.

A kick-off dinner in Illinois Tech's Commons building lounge will open the symposium on March 19. All other sessions will be held at the amphitheatre.

Miller said 15 technical papers on the making, use, and standards of diamond tools are to be presented by experts from the United States, Europe, and South Africa.

Your Pet Project MAY BECOME A PRIZE PAPER

Jot down the ideas you've had for a long time . . .

Maybe they'll help you think of others . . . Maybe they'll win you one of the five, $100 prizes

Here are the rules:

Any member of the Society may compete regardless of grade of membership.

Papers shall not be highly technical in nature. A clear, concise and interesting coverage is desired rather than complex formulae or derivations. The subject discussed should be of general interest to engineers but should not be of a political or highly controversial nature.

All members of the Society who wish to submit papers in this contest should contact the Secretary as early as possible and not later than February 1, 1956, and request a copy of the rules governing the competition and an outline of the minimum requirements for acceptance of papers. These cover in detail the mechanical make-up which should be followed in preparing and submitting papers for the contest.

Papers must be submitted to the Secretary for acceptance by April 1, 1956. If the Secretary finds that they meet the minimum requirements of the contest, he will forward them to the Awards Committee for review. The papers will be identified by number only. The Secretary of the Society is the only person who will maintain the key to the authors.

If any paper does not comply with such minimum requirements, the Secretary will so advise the author and discuss with him the points which are below the minimum requirements. The papers which are accepted will be forwarded to the Awards Committee for judging not later than May 1, 1956. Papers which have not met the minimum requirements by that time cannot be considered for prizes.

Papers which are accepted will be judged on originality of presentation, editorial merit and value to the engineering profession.

The papers submitted must not have been previously published in substantially the same form. No copyrighted materials shall be used unless permission has been obtained and so indicated. All manuscripts, drawings, etc., are to become the property of the Society and cannot be published without the consent of the Society.

If the papers submitted are NOT of sufficient merit to warrant the award of any or all of the prizes, the Awards Committee reserves the right to award less than the five established prizes or to postpone the competition.

The winners will be announced and the prizes presented at the annual meeting of the Society in June, 1956.

WSE Executive Secretary will furnish you with a complete set of rules and minimum requirements on request.

Ceramics Applied by New Process

A novel process for coating a wide variety of substances—by feeding powdered ceramic materials through a simple flame gun—has been developed at Armour Research Foundation of Illinois Institute of Technology, Chicago.

Coatings resulting from the process—called "Flame Spray Ceramics"—are superior to those produced by the metallizing processes because of their greater resistance to heat and chemical stability.

"In many cases, the underlying metal actually can be melted without causing coating failure," according to Samuel W. Bradstreet, supervisor of the chemistry of mineral products in the Foundation's ceramics and minerals research department.

The technique of application is similar to that required for the metallizing processes, he said. "Flame Spray Ceramics" are sintered layers of refractory and chemically inert materials, such as aluminum oxide or zirconium oxide.

The spray coatings do not require that the metal or other base be heated unduly —as opposed to ordinary ceramic coatings which require heating both metal and ceramic to high temperatures.

Since the two basic "Flame Spray Ceramic" coatings — aluminum oxide and zirconium oxide — are stable metal oxides, they cannot oxidize further, Bradstreet explained.

The alumina coating is harder than tool steel and unusually adherent in thicknesses up to about 10 mils. If applied more heavily, residual stresses may cause coating failure on sudden heating or cooling.

The coating appears to be extremely effective for protecting metals, such as steel and even aluminum, against high temperature erosion such as that encountered in rocket nozzles.

The hardness of the coating suggests its use for protecting soft metals—aluminum, die-cast alloys, or mild steel, for instance—against erosion and abrasion in pump impellers and housings, fan blades and turbines, and piping subject to cavitation.

The alumina coating is electrically insulative, and Bradstreet anticipates its use in the manufacture of high-temperature process equipment. The coating is poorly wetted by certain molten metals, and preliminary tests show it to act as a satisfactory permanent mold coating for aluminum casting.

"In this last respect, the zirconia coating should be even better, since it is more refractory and inert than alumina. Although the zirconia coating is somewhat softer and more difficult to apply, its resistance to corrosion and heat is outstanding," Bradstreet stated.

He predicted the coating will find use in rockets, flame ducts, burner equipment, and as a liner for troughs, feeders, molds, and other similar foundry equipment.

Like all sprayed coatings, "Flame Spray Ceramics" have a residual porosity of about 10 to 15 per cent and alone do not provide perfect protection against chemical corrosion of the underlying material.

However, various additives to the two basic coatings improve their protective action, and this can be improved further by overcoating with recent ARF-developed "Solution Ceramics," or by co-spraying with soft metals.

Bradstreet lists several other applications of "Flame Spray Ceramics" which have already been shown to have some value:

—Thermal protection of engine parts.
—Increasing wear- and skid-resistance of metal treads and gratings.
—Coating on graphite for reducing erosion, oxidation and wear.
—Decorative surface coating.
—"Wettable" coating for oil burner pans and grates.
—Catalyst coating for certain flame equipment.
—Anti-heat protection for aircraft parts.

Continental Coatings Corporation of Illinois, 2333 S. Michigan avenue, Chicago 16, has signed a license agreement with the Foundation in the service contract applicator field for use of ARF patents in the development.

The agreement gives Continental Coatings the right to sub-license other organizations throughout the country in the contract applicator field.

Lightweight Trains

(Continued from Page 6)

fact. On the other hand, many of our railroads are afflicted with frequent speed restrictions because of curves, etc. Any approach which permits higher speeds at these locations, with the corresponding reduction in braking and acceleration time, would automatically reduce overall schedule time with little if any increase in top speed. The improved power-weight ratio which would be provided in lightweight trains to maintain present maximum speeds would result in considerably improved acceleration characteristics.

This could be one reason why most of the present interest in these new trains seems to be concentrated in the East rather than with the Western roads with their long stretches of tangent track. The New Haven, for instance, while having few grades which would limit train speed has 218 curves in the 229-mile stretch between New York and Boston.

How can these objectives be accomplished? It seems that every car builder, most of the locomotive builders, and some of the aircraft builders all have their own opinions as to how a new type of train should be built. The only officially released announcement has been that ACF Industries will build a modified version of the Talgo train for the Rock Island Railroad. The Talgo as built originally for Spain, consisted of a series of single axle cars each about 20′ long. According to publicity releases, the American-version will be a three unit car mounted on four axles. There has been a considerable amount of trade publication gossip involving the Budd Company, General Motors, Grumman Aircraft, and Fairchild Aircraft, as well as my own company, Pullman-Standard. In addition to all these, a committee appointed some months back by the presidents of six large railroads has been studying designs submitted to them by the various car builders as well as some European train designs. This committee has also suggested a design for a lightweight car which would be somewhat lower than standard, with a drop center to achieve a lower center of gravity, but which would still have standard platform and coupler heights for operation with present conventional locomotives.

All too often this problem of weight reduction is approached solely as one of reducing weight of the structure. There are two ways of reducing structural weight without sacrifice of necessary strength. The structure can either be made smaller or lighter weight materials can be used. The car can only be made lower inside, or narrower at some sacrifice in passenger comfort. Therefore, we must use lighter materials. Even here, the gains are relatively small, since the structure represents only 20% of total car weight. Although aluminum weighs only one-third as much as steel, it is seldom possible to reduce the weight of structure by as much as one third, primarily because of the somewhat lower strength of the material and the different fabricating techniques required. Railroad cars are not built merely to hold themselves together during normal operation, but have built into them additional safety factors which are responsible for the safety record which the railroads have achieved.

Passenger deaths are rare even in what appear to be serious derailments. Weight reduction must not be made at the expense of safety.

Since it is apparent that a major reduction in car weight and cost cannot be obtained by redesign of the structure, then the savings must be made in equipment and appurtenances. With this purpose in mind, every item in the car must be carefully scrutinized for necessary redesign. Appreciable savings can be made in such items as inside finish, both in the materials used and in methods of application. Seats must be redesigned, lighting fixtures must be the best compromise between ruggedness and minimum weight, recent developments in air conditioning must be utilized, and so on throughout the car. Probably the two biggest fields in which outstanding gains can be made are in the electrical equipment and in the suspension and running gear arrangements. To the best of our knowledge, everyone engaged in this endeavor is proposing a radical change in both of these items.

Electrical auxiliaries on the majority of passenger cars today are powered by

a battery and axle driven generator system in voltages of 32, 64 or 110 direct current. The generator supplies power for the car and battery charging when the train is running above approximately 25 miles per hour. The batteries supply power at speeds below 25 MPH and at standing. Most cars have an AC motor in the same housing with the generator which drives the generator from wayside power when in terminals and yards. In order to obtain AC power for fluorescent lights, radios, sound systems, razors, etc., motor alternators must be used. All this equipment is more or less special for railroad use and is expensive to purchase and maintain. Our studies indicates that the most economical and desirable source of electrical power for a train would be a 440-volt, 60 cycle, three-phase alternating current generator driven by a diesel engine at one spot in the train. On long conventional trains this location might well be near the center of the train to cut down transmission losses. Most of the present plans for new style equipment include such a generator either in a special locomotive or in a transition car which would be used between an ordinary locomotive and the new train.

Figure 2 demonstrates the amount of equipment which could be removed from a conventional car through the use of centralized auxiliary power. All of these items add up to a net saving per car of 11,700 pounds. There is, of course, a very considerable weight to be added in the one car which would carry the generating equipment, but a net saving in train weight of 50 tons is easily possible.

The question might well be asked "why," if such savings are possible on conventional equipment, this hasn't been done long ago. Actually, it has. In fact, the first trains with electric lights were powered in just this fashion back in 1909. Many of the early streamliners built in the thirties included head end power. Trains so equipped were operationally successful, and the logic for their abandonment is rather obscure, but a lack of spare units or adequate provision for emergencies seems to have been the deciding factor. Non-interchangeability is usually given as the major reason.

While the savings possible in the electrical system itself are tremendous, the corollary advantages are also important. The equipment to be used is comprised of standard commercial items, most of which are carried as stock by the electrical manufacturers. Fluorescent lights become reasonable for use, since special motor alternators are not required. The air conditioning system becomes greatly simplified, since AC motors can be used for fans, and hermetically sealed compressors are possible. Maintenance would be greatly reduced by the elimination of commutators and brushes, and by the elimination of belt driven compressors. In addition to the above, train resistance can be greatly reduced by the removal of axle driven generators. At 50 MPH, a conventional train requires some 800 horsepower from the locomotive just to run the axle generators. The same opwer requirements can be met by a 600 horsepower diesel engine directly driving an AC generator.

Present day conventional cars are equipped with trucks which constitute practically one-third of the lightweight of the car. This weight is definitely excessive and such a ratio cannot be tolerated for any really lightweight, low-cost design. Many of the new proposals contemplate complete abandonment of the four wheel truck as such, replacing it with a single axle arrangement at one or both ends of each car. Such a supporting method introduces new problems of axle steering if the car is to track properly on tangent and curved track at all speeds in both directions. (The various builders have been very reluctant to discuss the means by which they hope to accomplish this result). Studies have also been made on lighter weight four wheel trucks. With either approach, there is a new factor which heretofore has been unimportant in passenger car design. As weight of the car is reduced to approach 700 pounds per passenger; passenger weight itself becomes an appropriate portion of overall weight. Since good vertical ride can only be achieved by soft spring rates, a 25% increase in load due to passengers could easily mean excessive variations in car height between empty and loaded. This is the primary reason some of the new designs are being planned with air springs which will automatically adjust the car height regardless of load.

"Train X"

One version of lightweight train design has become popularly known as "Train X."

This design was fostered by K. A. Browne, director of research of the Chesapeake & Ohio Railroad. Pullman-Standard collaborated in research and development, and in 1950, produced a prototype car. One experimental passen-

EQUIPMENT & WEIGHT ELIMINATED FROM CONVENTIONAL AXLE POWERED CAR
(64 VOLT SYSTEM) BY THE USE OF CENTRAL AUXILIARY POWER–ELECTRICAL SYSTEM ONLY

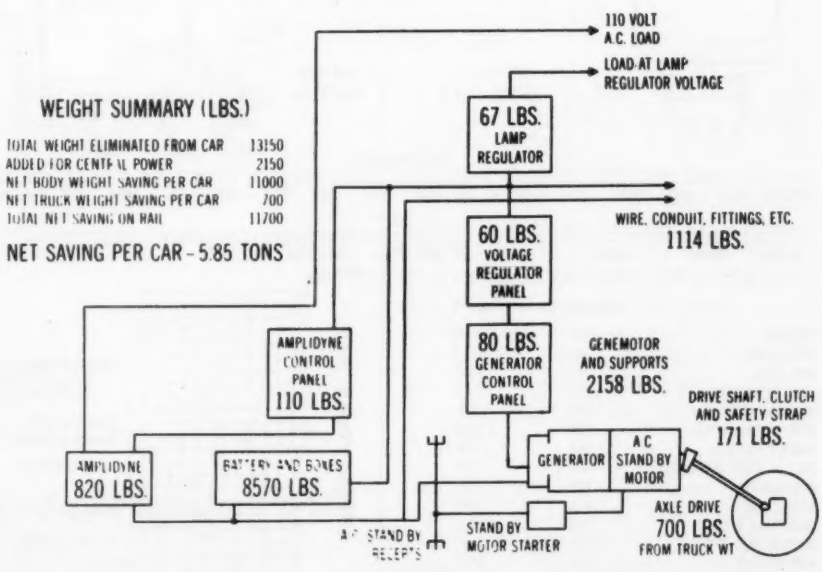
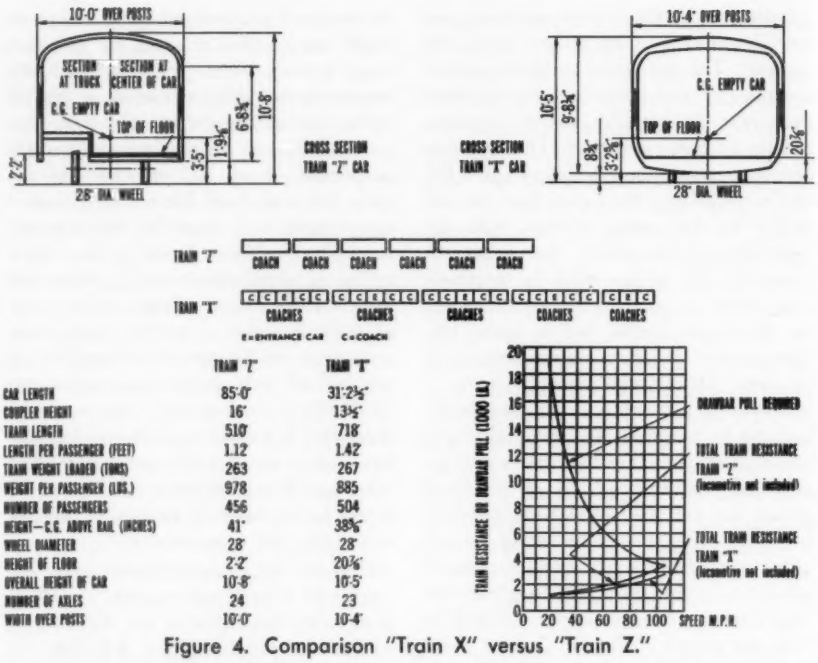


Figure 2.

ger car, a transition car, and an observation car mock-up was built. Extensive tests have been conducted by both Pullman-Standard and the Chesapeake & Ohio Railroad with speeds to 105 MPH.

Aluminum superstructure cars are of the steered single axle in rear type, with front end of each car supported by the car ahead except when uncoupled. Under the latter condition, front end support is by retractable dolly wheels which are lowered for switching and backing. Head end auxiliary power is provided. Automatic couplers have been developed. "Train X" will meet all AAR requirements. Center of Gravity is approximately 1 ft. 6 in. lower than the conventional car. Fresh air at 300 cfm is provided through a roof inlet. Each car has a fresh-air blower and a circulating blower. General illumination is by fluorescent tubes. Suspension is provided with air spring with torsilastic stabilizers. A self-leveling-type valve maintains constant floor height irrespective of load.

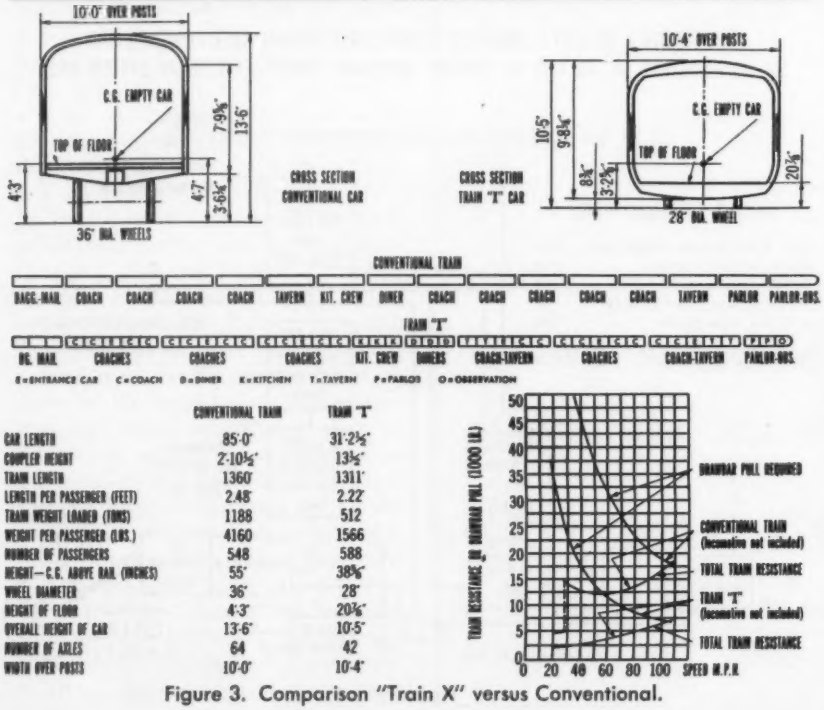


	TRAIN "Z"	TRAIN "T"
CAR LENGTH	85'-0"	31'-2½"
COUPLER HEIGHT	16"	13½"
TRAIN LENGTH	510'	718'
LENGTH PER PASSENGER (FEET)	1.12	1.42
TRAIN WEIGHT LOADED (TONS)	263	267
WEIGHT PER PASSENGER (LBS.)	978	885
NUMBER OF PASSENGERS	456	504
HEIGHT—C.G. ABOVE RAIL (INCHES)	41"	38⅝"
WHEEL DIAMETER	28"	28"
HEIGHT OF FLOOR	2'-2"	20¾"
OVERALL HEIGHT OF CAR	10'-8"	10'-5"
NUMBER OF AXLES	24	23
WIDTH OVER POSTS	10'-0"	10'-4"

Figure 4. Comparison "Train X" versus "Train Z."

Comparison "Train X" Versus Conventional

Figure 3 shows a comparison of two coach trains—one "conventional" and the other "Train X." Both have luxury accommodations and are essentially of the same floor space and accommodations with respect to comfort. The conventional train has 16 modern air-conditioned cars with stainless steel superstructure and high-tensile low-alloy steel underframes. Four-wheel trucks are provided. "Train X" cars are as previously described. Resistance-speed and drawbar horsepower-speed curves are shown, with resistance as computed by a modified Davis formula. Train X cars are considered to be in 93 ft. 7½" units with three axles. Weights shown are high. All curves are for level tangent track operation and with fully loaded trains. Resistance shown is that for the total train only (locomotive not included), and drawbar pull is that required for train operation to 100 mph.



	CONVENTIONAL TRAIN	TRAIN "T"
CAR LENGTH	85'-0"	31'-2½"
COUPLER HEIGHT	2'-10½"	13½"
TRAIN LENGTH	1360'	1311'
LENGTH PER PASSENGER (FEET)	2.48'	2.22'
TRAIN WEIGHT LOADED (TONS)	1188	512
WEIGHT PER PASSENGER (LBS.)	4160	1566
NUMBER OF PASSENGERS	548	588
HEIGHT—C.G. ABOVE RAIL (INCHES)	55"	38⅝"
WHEEL DIAMETER	36"	28"
HEIGHT OF FLOOR	4'-3"	20¾"
OVERALL HEIGHT OF CAR	13'-6"	10'-5"
NUMBER OF AXLES	64	42
WIDTH OVER POSTS	10'-0"	10'-4"

Figure 3. Comparison "Train X" versus Conventional.

Comparison "Train X" Versus "Train Z"

It is also of interest to compare "Train X" with a low center of gravity, 28-in diameter wheel, 85-ft-car-length train which we shall refer to as "Train Z." See Figure 4. This comparison is based upon near identical train weights (cars only). "Train Z" utilizes certain of the desirable features of "Train X." However, four-wheel trucks are used—modified to obtain maximum benefit from the lower center of gravity. Conventional center sill construction has been eliminated and replaced with suitable side structural members. Wheel wells are provided above the trucks thus allowing the low 41-in center-of-gravity height above rail. Couplers, draft gear and such appliances are conventional but designed for the lower weight car.

. . . New propulsion power would be desirable, with auxiliary front end power on short trains, and central auxiliary power on trains with more than eight cars. Alternating current, 440 volt, 3-

phase, would be proposed for all parasitic loading such as air-conditioning, heating, lighting, etc.

Conclusion

In the view of the many and diverse approaches, the next year or two, during which these various designs approach reality and are put to the test of actual service on the nation's railroads, should prove to be a very interesting period. It is to be hoped that the mistakes made 20 years ago will not be repeated, and that once on the way we will not again revert to conventional equipment. If the builders are expected to build individual prototype trains with no standby equipment for emergency use, and these trains are then expected to have better availability than present equipment on which every item is tried and proven over many years, the going will be indeed rough. If, however, the railroads will test these trains, and then permit the builders to construct them in standardized form in quantities sufficient to realize the inherent savings from semi-mass production, we might well be witnessing the beginning of a revolution in the railroad industry comparable with the introduction in 1864 of George M. Pullman's first real sleeping car, the "Pioneer."

Now, Now!

Mankind are very odd Creatures: One Half censure what they practise, the other half practice what they censure: the rest always say and do as they ought.

—Poor Richard's Almanack

Device at Armour Aids Blast Research

The addition of a new laboratory device has expanded the facilities of Armour Research Foundation of Illinois Institute of Technology, Chicago, to all aspects of blast effects research.

The instrument—known as a "strong shock tube"—will be used by engineers in the Foundation's propulsion and structural research department to study the behavior of air at very high temperatures and pressures similar to those produced by nuclear explosions.

Designed to operate at pressures up to 40,000 pounds per square inch and at temperatures as high as 20,000° Fahrenheit, the instrument also will enable scientists to study the effects of high temperature gases on materials such as those used for liners in rockets or combustion chambers.

Other possible uses, according to the project engineer, Stuart A. Hoenig, are in studies of the production of radio waves by hot gases similar to those of the sun, investigations of astro-physical phenomena, and studies of rockets and missiles.

The strong shock tube is 15 feet long with a two-inch inside diameter and one-inch thick steel walls. It is the third instrument of this type to be constructed by Foundation engineers.

The first instrument—an eight-inch tube for lower pressure experiments—was developed in the ARF laboratories for blast model tests and fundamental aerodynamic studies.

The world's largest shock tube was designed by the Foundation for the Air Force and has been built at Gary, Ind. The Gary tube is 150 feet long with a 6-foot diameter and is used to study effects on large scale models of buildings which might be exposed to bomb blasts.

To operate the shock tube as a laboratory instrument for generating controlled shock waves, a certain amount of combustible gas is introduced into one section of the tube and is confined therein by a copper diaphragm, according to Hoenig.

The diaphragm is shattered when the gas is ignited, and the released pressure wave travels down the tube to the test section, he explained. The resulting pressures and temperatures are recorded with electronic and optical equipment.

Professional Directory

EDWARD J. WOLFF

ELECTRICAL . . .
MECHANICAL . . .

CONSULTING ENGINEERS
308 WEST WASHINGTON STREET
CHICAGO 6, ILLINOIS

E. R. GRITSCHKE and ASSOCIATES

Consulting Engineers

Designers of
MECHANICAL and ELECTRICAL SYSTEMS for BUILDINGS

11 S. LaSalle St., Chicago 3, Ill.

SOIL TESTING SERVICES, Inc.

Consulting Engineers

Carl A. Metz
John P. Gnaedinger

Soil Investigations
Foundation Recommendations and Design
Laboratory Testing

3521 N. Cicero Ave., Chicago 41, Illinois
7323 W. Center St., Milwaukee 10, Wisconsin
1105 E. James Street, Portland, Michigan

THOMAS J. HIGGINS ASSOCIATES, Inc.
School Buildings and Surveys
228 No. LaSalle St., Chicago 1

George I. Uitti, President
Structural Engineer

STate 2-6492

KORNACKER & ASSOCIATES, INC.

ENGINEERS

Bridges, Highways, Expressways and Railways, Building Structures, Industrial Plants, Supervision, Foundations and Soils, Investigations and Reports, Sewerage and Sewage Disposal, Surveys.

53 West Jackson Blvd.
Chicago 4, Illinois

VERN E. ALDEN CO.

Engineers

Design and Supervision
of Construction

Industrial and Chemical Plants
Steam Power Plants

33 North LaSalle St.
Chicago 2

ESTABLISHED 1913

WALTER H. FLOOD & CO.

CHEMICAL ENGINEERS

Inspection and Testing
Of Materials and Structures
Buildings, Roads, Streets, Airports
SUPERVISION OF CONSTRUCTION
CONCRETE CORE CUTTING
6102 S. BLACKSTONE AVE. CHICAGO 37
Branch—1332-4 N. Westnedge Ave.
Kalamazoo 53, Mich.

SARGENT & LUNDY

ENGINEERS

140 S. DEARBORN STREET

CHICAGO, ILLINOIS

Alvord, Burdick & Howson

ENGINEERS FOR

Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation

20 N. Wacker Drive - Chicago 6

Telephone: CEntral 6—9147

DE LEUW, CATHER & COMPANY

Consulting Engineers

Transportation, Public Transit and Traffic Problems

Industrial Plants	Grade Separations
Railroads	Expressways
Subways	Tunnels
Power Plants	Municipal Works

150 N. WACKER DRIVE, CHICAGO 6, ILL.

JENKINS, MERCHANT & NANKIVIL

Consulting Engineers

Municipal Improvements	Sewerage
Power Development	Water Systems
Traffic Surveys	Industrial Plants
Flood Control	Recreational Facilities
Airports	Investigations and Reports

805 East Miller Street
Springfield, Illinois

ROBERT W. HUNT COMPANY ENGINEERS

Inspection • Tests
Consultation
•
Engineering Materials
•
Cement • Concrete • Chemical
Physical and Metallurgical
Laboratories

175 W. Jackson Blvd., CHICAGO. And All Large Cities

Your Card* on this or the opposite page will acquaint others with your specialized practice.

*Restricted to Professional Architects and Engineers.

AIEE Schedules Fall Meeting for Oct. 3-7

The American Institute of Electrical Engineers will hold its Fall General Meeting in Chicago during Oct. 3-7, with headquarters at the Morrison Hotel.

This is the second year in succession that AIEE has held its convention in Chicago.

The technical program, inspection trips, and social activities will occupy the entire facilities of the Morrison Hotel during the five-day meeting.

A large and varied technical program has been planned with special attention to the subject of rotating machinery, and communications.

Seven sessions will be devoted to rotating machinery. Six sessions will be concerned with the various aspects of electrical communications, two of which will be on television and aural broadcasting. Two sessions have been organized by the new Committee on Dielectrics. Sessions are also scheduled by the General Committees on Education, Management, and Safety.

On Oct. 3 at the General Session, an address of welcome will be presented by the president of the Illinois Bell Telephone Co., who is a member of WSE, William V. Kahler.

Social activities will include a reception tea and hospitality hour sponsored by AIEE's Chicago section.

Engineering Societies Personnel Service, Inc.

New York Chicago Detroit San Francisco

These items are from information furnished by the Engineering Societies Personnel Service, Inc., Chicago. This SERVICE, operated on a co-operative, non-profit basis, is sponsored by the Western Society of Engineers and the national societies of Civil, Electrical, Mechanical and Mining and Metallurgical Engineers. Apply to ESPS, Chicago and the key number indicated. Prepared ENGINEERS AVAILABLE advertisements limited to 40 words, with typed resume attached may be submitted to ESPS Chicago by members of Western Society of Engineers at no charge.

If placed in a position as a result of an Engineers Available or Position Available advertisement, applicants agree to pay the established placement fee. These rates are available on request and are sufficient to maintain an effective non-profit personnel service. A weekly bulletin of positions open is available to subscribers. Apply ESPS Chicago.

POSITIONS AVAILABLE

C-3563 Mech. Engr. ME Age: 25-45. 5 yrs. in practical mech. engrg. Know: Bldg. constr., mech. eqpt., workmanship & materials. Duties: Design & estimate mech. aspects of new constr. & repair work. Inspect bldgs., heating, vent., & air cond. systems. Prepare specs., prepare work schedules & supervise work. For Educ. Inst. Sal: $550-$850. Loc: Illinois.

C-3574 Research Adm. BS or better in Mech. Chem. Appl. physics. Age: 35-42. 10 plus yrs. exp. in applied research adm. Teaching at college level helpful. Know: Thermodynamics & fluid mechanics. Duties: Asst. in mgmt. of well organized res. lab. Contact, coordinate & promote activities in head power & fluid flow. For Res. Org. Sal: Abt. $10,000. Location: Chicago.

C-3588 Plant Layout. Age 40-55. 3 plus yrs. exp. in plant layout & tooling in sheet metal & stampings. Know: Punch presses, shears & brakes. Duties: Plant layout engineer as staff engineer for a consulting engineer. For Consultants. Sal: $800. Loc: Chicago. Empl. will negotiate the fee.

C-3590 Sales Trainee. ME or EE Age: Up to 30. Recent Grads. or better. Duties: Project work service approval, field serv. & engrg. sales correspondence & other assignments, training for sales work in car heaters, temperature controls, & allied eqpt. For Mfr. Sal: $375-$550/mo. Loc: N.W. Chgo. Sub. Employer will pay fee. 20% traveling.

C-3591 Sales Engr. EE Age: Up to 35. 2 plus yrs. exp. in aircraft controls, sales, appl., or development. Know: temp. controls. Duties: Service approval & engrg. improvements, field service & engrg. & Sales Work. For Mfr. of controls. Sal: $600-$675/mo. Loc: N.W. Chicago Sub. Employer will pay the fee. 20% traveling.

C-3592 Statistical Quality Control. Chem. Chem. Engr., or Science. Age 25-40. 2 plus yrs. exp. in quality control work in light industry either processing or textiles. Know: statistical control procedures. Duties: handling statistical quality control in finished goods department or raw materials testing & inspection department. For Mfr. of fixtures. Sal: $4200-$5500. Loc: Chicago. Empl. will neg. fee.

C-3596 Off. or Field Engr. CE 2 plus yrs. exp. in field or office on highway work. Duties: can use man either in field on survey & layout of toll roads or in the office on design of highway projects. Sal: $100-$125/week. Loc: Calumet area.

C-3597 Arch. Engr. Arch. Age: 25-30. 3 plus yrs. exp. in arch. office designing & detailing. Duties: to start on board on arch. design of industrial bldgs. Should have potential to develop into contact man for company eventually. For Engrg. firm. Sal: $3.00-3.50 hr. Loc: Chgo. Employer will negotiate the fee.

C-3600 Designer & Appl. Engr. EE 2 plus yrs. exp. in motor & dynameter work. Duties: Design & appl. engrg. to meet customers requirements on motor & dynameters ranging from fractional hp. to 8K. V.A. Good personality. Small amount of traveling. For Mfgr. Sal: $100-165 depending on experience. Loc: Illinois. Employer will pay the fee.

C-3602 Design & Devel. ME Age: 25-plus. 2 plus yrs. exp. in design & develop. of small devices. Duties: design & devel. of small parts & sub assemblies of welding devices. All research & design of small medical gas eqpt. used in hospitals & doctors' offices. For Mfgr. Sal: $450-$550. Loc: West side of Chicago.

C-3610 Project Engr. ME Age: 35-plus. 10 plus yrs. exp. in special machy. & tool & die design. Know: Metal forming operations. Duties: small organization therefore work is varied. Will take project on special machy. des. follow thru from inception to production. Likewise with tools & dies necessary for mfg. company's products. For Mfgr. of rolled & extruded trim & struct. shapes. Location: Chicago. Sal: $7800 plus. Employer will negotiate the fee.

ENGINEERS AVAILABLE

282 MW Quality Control Mgr. 45 ME 14 yrs. exp. in test, inspection, quality control methods; 10 yrs. planning engr. in metal working shop. $10,000 U. S.

284 MW Metallurgist 34 Met. 2½ yrs. open hearth shift supv. 6 mos. Asst. Ch. Metallurgist. $5400 Chicago.

285 MW Chem. Engr. 31 Ch.E. 6 mos. Jr. Res. Engr.—pilot plant, filtration studies. 5½ yrs. lab. supv. Development & testing oil filters. 8 mos. asst. engr. writing material specs., developing. $6500 Chicago.

286 MW Project Engineer 30 ME 4 yrs. exp. in devel. & design of devices relative to pneumatic temperature control industry. $6000 Chicago.

287 MW Met. Engr. 31 Met. Engr. 5 yrs. exp. in res. devel. & process control; metal working steel, non-ferrous & powder metallurgy. $8400 U.S.

288 MW Ch. Engr. 41 ME 10 yrs. resp. for maint. of plt. & bldgs; design & constr. of special eqpt. 3½ yrs. member of staff & charge of 20 drftsmen. 3 yrs. designed auto radios & build models. $11,000 (open) Midwest.

289 MW Plt. Engr. 29 ME 2 yrs. set up methods & procedures for metal working and upholstering plants. 2 yrs. project & dev. engr. for rubber mfgr. 3½ yrs. project engr. doing field supervision on the bldg. of edible oil chemical plant. $6500 Chicago.

290 MW Designer 40 EE 6 yrs. supv. of product design group doing design, layout, detailing & spec. writing. 1 yr. resident engr. on elect. distribution systems. 6 yrs. resident Sperry engr. on ordnance eqpt. 4 yrs. made voltage investigations. $7800 U.S.

291 MW Field Engr. 27 CE 3 mos. detailed, estimated quantities, etc., for consultant. 10 mos. field engr. on highway construction. $5200 Chgo.

292 MW Field Engr. 32 Geology 3 yrs. resident engr. charge of constr. 2 yrs. mine engr., including surface underground mapping and mine performance. 1 yr. on surveys for site development. $8000 Midwest.

Key to Solvency

(Continued from Page 9)

experience except on a larger scale. Earnings in 1936 were an impressive $65,000 and by the end of 1936 the net worth had been built up to $100,000, almost all of which was represented by working capital.

With two years' successful experience under its belt and with the self-confidence that comes from success, the management decided to go to town in 1937. A sales budget of nearly $3,000,000 was set-up. Distributors signed contracts to take the output and suppliers signed contracts to provide the component parts. The budget for 1937 indicated a profit of nearly $200,000 and the projected balance sheet for the end of 1937 showed a tangible net worth of $300,000 with small indebtedness covered by cash along with a strong margin.

That certainly was a rosy outlook, but as I examined that budget early in 1937 my heart sank because the budget clearly showed a high turnover of working capital with all its attendant risks.

You will recall that 1937 was the year in which sitdown strikes suddenly became fashionable. Two or three of the suppliers of this company were shut down by such strikes, with the result that they were unable to ship component parts to this important customer. Lacking the component parts, the company was unable to complete the finished products, and without the finished products it could not meet its sales contracts on time. Being unable to ship the finished merchandise, it could not get the revenue to cover its operating expenses and the final result was that in September 1937 the tangible net worth was in red figures and creditors took over. Thus, you will see that an overtrading position, while frequently resulting from overexpansion in fixed assets, can nevertheless exist and be disastrous even though the investment in fixed assets is still nominal.

In case you are interested in later developments of this case, the creditors saw that there was nothing wrong with this company that some sound financial policies wouldn't cure. So they permitted it to start over again on a less ambitious scale, and the management, having learned a painful lesson, moved ahead more slowly but more soundly, and today that company has our highest rating.

In passing, I would like to make a practical suggestion which I have used many times and which, if it had been used by many managements, could have saved some significant losses. If a management is contemplating any material expansion in its fixed assets, let it first compile a "giving effect" balance sheet which will show what the condition will be after that expansion is completed. That "giving effect" balance sheet will show the effect of the plant expansion upon the working capital, and if it should indicate that the company will then have insufficient working capital for the anticipated sales volume, it might be very wise to reconsider the plant expansion.

Relationship of Inventories to Working Capital — Key Number 3

The third fundamental is concerned with inventories. Most business men under normal conditions try to keep their inventories in line with current requirements because such a practice reduces the risk of loss from obsolescence, deterioration and style changes, and it keeps the company in a more liquid position so that it is better able to take advantage of any favorable buying opportunity which may arise. Of course, there's no substitute for good buying judgment — wrong inventories may be worse than long inventories. Business men generally try to get an idea of what the typical turnover of inventories is in their lines of business, and so long as their companies are successful in minimizing dead spots in stock and maintaining a general inventory turnover in line with their industries, they tend to become satisfied with their accomplishment and then put their minds on some of the many other problems that always confront a business man.

That reasoning is perfectly sound and it is desirable that it be followed but it doesn't always go far enough, because sometimes inventories can become too heavy even though they may be turning actively. If this is true (and I ask you to accept it as true until I can prove my point), then what we need, obviously, is some check on inventories, something which will tell us when general inventory

turnover becomes too heavy even though it is still in good relationship to sales. That check will be found in a comparison of inventories with working capital. Here, we do not find the wide variation that we find in the relationship of fixed assets to tangible net worth or in the relationship of sales to working capital. In practically every line of industry in which inventory is a significant factor, we find that inventories generally are equivalent to something around 60% to 80% or 90% of the working capital. There are a few exceptions such as retail drugs, shoes, and wholesale and retail grocers, in which inventories frequently run up around 100% of the working capital, but my general statement still stands.

Inventories can be built up considerably from the usual 60% level without jeopardizing the essential financial soundness of an enterprise, but the danger point arises when they become equivalent to 100% of the working capital. This leads to the third fundamental which may be expressed like this. "A company's investment in inventories should be kept within 100% of its working capital." Above 100% the company becomes vulnerable no matter how actively its inventories are turning.

To make this clear I am going to ask you to look at a balance sheet. Almost any balance sheet will do. On one side we see some current liabilities consisting probably of notes payable to the bank, accounts payable, accruals, and any other item of indebtedness that matures within one year of the statement date. A significant feature of these current liabilities is that they represent definite, legally enforceable claims for specific sums of money.

On the other side of the balance sheet we find some current assets consisting generally of cash, receivables due from customers, and inventories. The cash and receivables, like the current liabilities, consist of definite, legally enforceable claims for specific sums of money, in this case the claims being against others. The inventories, however, with certain rare exceptions constitute no claims against anybody for anything. They are worth only what they will bring when they are sold.

We credit men have a saying in which there is a lot of common sense, namely, that a company with cash and good receivables covering its current liabilities is in a generally acceptable financial condition. What we mean is that if times suddenly become tough, a company with cash and receivables covering its current liabilities will find itself with cash on hand and coming in from its enforceable claims against others in an amount sufficient to meet the enforceable claims against itself. And while it may have an uncomfortable time for a while and may even take some losses, it will at least have that vitally precious time in which to readjust itself to the changed conditions. But the company without cash and receivables covering its current liabilities does not have cash on hand and coming in in an amount to meet its maturing obligations. Unless it can borrow money somewhere, it will be dependent, in the event of some unfavorable developmnt, upon liquidation of inventories in order to get money. But that will be just when its customers do not want to buy. On the contrary they are more interested in cancelling orders and in liquidating their own inventories. If cash and receivables fail to cover the current liabilities by any significant margin, the company may find itself unable to dispose of sufficient merchandise, and then its problems really begin.

Now it always happens that the moment a company's inventory exceeds 100% of its working capital, then its cash and receivables fail to cover its current liabilities. Because the consequences of having insufficient cash on hand or coming in to meet maturing obligations can be so disastrous, it follows that as a matter of fundamental policy a management should always keep its inventories less than 100% of the working capital, no matter how actively the inventories are turning.

Conclusion

These three fundamentals, (1) keeping fixed assets in line with net worth, (2) keeping working capital in line with sales, and (3) keeping inventories less than 100% of working capital, are in my opinion the basic ones which a management must observe if an enterprise is to maintain a sound financial condition.

Admittedly there are other relationships which we credit men regard as important. For instance, we don't like to see excessive indebtedness or too low a current ratio. But invariably an excessive debt or too low a current ratio is a result and not a cause. It is the result of a violation of one or more of these three principles or of the objective of keeping inventories and receivables turning actively, or of some combination of these factors. Any concern which will establish for itself and follow these three fundamental policies and, in addition, which keeps its inventories and receivables turning reasonably well will automatically be in a sound financial condition, and its ability to meet its obligations punctually as they mature will follow as a logical inevitable consequence.

Here I have been advocating with all my power the following of sound financial policies. But am I trying to put management in a straitjacket? Strange to say, not necessarily. Sometimes I think it can be good business judgment deliberately to violate these principles. Let me illustrate: a manufacturer of silk shower curtains tore off to New York the day after Pearl Harbor and bought all the silk piece goods he could get. As a result, his inventory ran up to 500% of his working capital, clearly a violation of a fundamental. But he figured that we could not defeat Japan within six to nine months, that during that period there would be no more raw silk imports and, therefore, no more silk piece goods, and that he would have ample time to convert his raw material into finished shower curtains at a profit. And that is exactly what happened.

The point I make here is that he knew what he was doing. Having deliberately taken a risk and emerged successfully, he returned to fundamentals. What worries me is to observe a management violating fundamental financial policies without realizing what it is doing. That leads too frequently to disaster.

In conclusion, I should like to refer to what I said at the beginning, namely, that there are five major functions in running a business enterprise: buying, production, selling, administration, and financing. All five are important, and I do not minimize in the slightest the importance of the first four. But handling the finances is important, too. If you will show me a concern that is doing a good job in all five, I am sure that you will also be showing me a concern which is both prosperous and financially sound. I think that goal is well worth striving for.

Management Group Set for Oct. Meeting

The Institute of Management Sciences has just completed arrangements for its second Annual National Meeting at the Park Sheraton Hotel in New York on Oct. 20-22.

The success of the first Annual National Meeting in Pittsburgh a year ago indicates that this three day session will bring many members—and their guests—from all over the country to listen in on the timely comments of selected speakers on subjects of importance to the advancement of management science.

The program will emphasize the need of a "forward look" to the objective planning of management in evaluating the driving forces of change—immediate and most distant—changes in the economy—in individual markets—changes in management technology through electronics—to further the applied use of mathematics as a productive tool of management—to facilitate the advancement of Automation as a means of attaining a higher standard of living and the security of our country—including a better understanding of human relationships in the process of these changes.

Particular emphasis will be placed on the application possibilities of data automation and related electronic computing devices as power tools for the rapid preparation of statistical intelligence, for management to maximize for productive resources as a means of assuring higher standards of living for our rapidly growing population.

A Way to Win

'Er you remark another's sin,
Bid your own conscience look within.
—Poor Richard's Almanack

WSE Personals

Harold R. Heckendorn, MWSE, 4473 Franklin ave., Western Springs, who has been an assistant superintendent of production control and results attached to the staff of the vice president of the Western Electric company's western area, has been promoted to a superintendency at the company's Hawthorne works, it has been announced. The change is effective September 15.

In his new post, Heckendorn will be in charge of the company's plant at Fullerton and Normandy avenues in Chicago.

He has been associated with the telephone industry since 1934, when he joined the independent United Telephone company. He went to Western Electric as an equipment engineer in 1941, and became a department chief at the Hawthorne works in February, 1951. He advanced to the post of assistant superintendent in October, 1952.

Born in Cedar Point, Kas., Heckendorn was graduated from Kansas State college in 1934 with a bachelor of science degree in electrical engineering. He later attended evening classes in the Northwestern university graduate school.

Heckendorn is a past chairman of the Chicago section of the American Institute of Electrical Engineers. He is also a member of the Chicago Acoustical and Audio association.

* * *

Russell E. "Andy" Anderson, MWSE, one of the electrical industry's most liked and better known members, has retired. He was vice president of the Delta-Star Electric Division of H. K. Porter Company, Inc. Anderson completed 35 years with the company, and to use the words of the company, "he has contributed enormously to its success and growth . . ." In 1920, on the first of June, Anderson joined Delta-Star as a sales engineer. In 1929 he was made assistant sales manager, and in 1936, sales manager. He was made a vice president in 1941.

Anderson went to high school in Iron Mountain, Mich., and was graduated from the University of Michigan with a B.E.E. degree.

During World War I Anderson served in France in the American Expeditionary Forces.

Anderson will still serve Delta-Star in an advisory and consulting capacity. However, he and his wife will live in their Florida home at Delray Beach.

Over 2,000 Expected To Attend Clinic

More than 2000 production executives and methods engineers are expected to attend the 19th Annual Time and Motion Study and Management Clinic sponsored by the Industrial Management Society scheduled for Nov. 9-11, 1955, at the Hotel Sherman, Chicago.

Thirty leading authorities from management, labor and industry will discuss the latest developments in the fields of time study, motion economy, job evaluation, production control, methods, plant layout, incentives, and human relations.

In addition to the technical sessions, an industrial exhibit will be held featuring new products, processes, and services applicable to the industrial engineering field.

Feature of the event will be the Annual Methods Improvement Competition, with awards to companies and colleges for outstanding advances in industrial engineering techniques and applications.

ASHAE to Make New Noise Study

A new study of noise from air conditioning equipment and installations will be started this fall by the Research Laboratory of the American Society of Heating and Air-Conditioning Engineers.

This announcement was made by Elmer R. Kaiser, ASHAE director of research, Cleveland, Ohio, following the endorsement of the plans by the National Association of Fan Manufacturers and the Industrial Unit Heater Association. Both of the endorsing organizations have their headquarters in Detroit, Michigan.

The immediate objective of this project, according to Kaiser, is the development of a basic method of sound measurement which can be adopted as a standard so that this noise control can be organized on an engineering basis. The need for this sound "yardstick" has been apparent to acoustics experts and air conditioning engineers for several years. Financial support for the program is now being encouraged from individual companies manufacturing fans, blowers, motors, compressors, air conditioner units and other component parts such as ducts, fittings, and grilles.

"All measurements of noise level, even by different operators, should be on a comparable basis," said Kaiser. "Furthermore, the noise level scale should be related to loudness as noted by the human ear. Decibel readings alone are inadequate because they indicate only sound pressure. Loudness is also a function of sound frequency or pitch. A practical measuring technique must combine the sound energies produced at different frequencies. A complication calling for a number of determinations on, say, a fan is the variation in noise emission in different directions."

The Technical Advisory Committee on Sound and Vibration Control is under the chairmanship of Harold A. Lockhart of Chicago. This Committee has carefully assembled and screened numerous technical suggestions in organizing the program. In addition to the measuring technique, the program seeks to determine the attenuation of sound in ducts, and the regeneration of noise by turbulence in duct fittings and dampers.

Watch, if You Want Some Excitement

Escape for the crew of a Boeing B-52 Stratofortress will provide an exciting sight for detached observers, *Aviation Week* notes. Entire tail turret blows off, carrying the gunner with it. Three of the other five crew members eject upward while two use downward ejecting seats.

Reviews of Technical Books

Radiochemistry

Nuclear and Radiochemistry, by Gerhart Friedlander and Joseph W. Kennedy, John Wiley & Sons, Inc., New York 16, N. Y. 1955. 468 pages. Price $7.50.

This is a thoroughly revised version of *Introduction to Radiochemistry*, and brings the subject matter closer to the requirements of modern research workers.

An up-to-date introduction written from the point of view of the chemist, *Nuclear and Radiochemistry* attributes a narrower meaning to "radiochemistry." Eliminating nuclear chemistry from this particular term, Friedlander and Kennedy now mean it to include chemical manipulations of radioactive sources and much of tracer chemistry. A considerable part of the book's reconstruction results from this change of approach.

The chapters entitled "Nuclear Energy" and "Some Cosmic Problems" are entirely new, the first dealing with nuclear reactors and military applications, and the second going into the energy production in stars, cosmic rays, cosmic and geological dating methods, and the origin of the elements. Completely rewritten, the chapter on "Atomic Nucleii" streamlines the review of atomic structure, and expands the treatment of spin, statistics, parity, and nuclear systematics. The revised chapter, "Radiation Detection and Measurement," takes into account the rapid development in nuclear measurement instrumentation during the past six years. There is also new material on nuclear shell structures, equations of transformation in a neutron flux, alpha-decay systematics, radiation chemistry, decay scheme studies, rates of isotopic reactions, and other points.

In addition to the chapters already listed, the book contains headings on radioactivity, nuclear reactions, production and study of nuclear reactions, equations of radioactive decay and growth, nuclear states and radioactive processes, interaction of radiations with matter, statistical considerations in radioactivity measurements, techniques for the study of radionuclides, and tracers in chemical applications.

Dr. Friedlander is senior chemist at the Brookhaven National Laboratory. He was formerly associated with the Los Alamos Scientific Laboratory and the General Electric Company. Dr. Kennedy is professor of chemistry and chairman of the department at Washington University. He was also at the Los Alamos Scientific Laboratory and before that, taught at the University of California in Berkeley.

Type 630 Receivers

Handbook of 630-Type TV Receivers, by Simon S. Miller and Howard Bierman, John F. Rider Publisher, Inc., New York 13, N. Y. 1955. 200 pages, paper covered. Price $3.50.

The "630" TV Receiver that RCA introduced, has been the basis for the designs of many millions of television receivers used throughout the U. S. Not only did many manufacturers use this circuit as initially designed, but as the years passed, they made modifications and improvements on it, and they appeared as the annual output. Today the "630" is a by-word in the television-receiver industry. It is a by-word not only among the manufacturers but among all people who are active in the repair of the nation's television receivers.

Handbook of 630-Type TV Receivers is a completely new approach in the presentation of servicing information on this type of receiver. This book sets forth the "why's" and "how's" of each of the original 630-type receiver sections. It then analyzes and explains in detail the many modifications and improvements which were made by the different manufacturers of this receiver to date. The circuit functioning is explained, and the use of and need for critical components are discussed. The symptoms of failure are given along with causes and remedies. In this respect this book is much more illuminating on the details about the operation and repair of the receiver than any information available today—even from the receiver manufacturers.

Conversion data in the form of procedures for converting older sets to larger picture tubes, adding keyed automatic gain control, improving video gain, reducing 4.5 mc interference, improving fringe area reception, accommodating uhf reception, and many other extremely valuable and informative details are given. Many complete trouble-shooting charts are included to make servicing easier.

Handbook of 630-Type TV Receivers is a very definitive work covering the many millions of this type receiver in use today. A full 26 pages have been devoted to trouble-shooting charts alone, which are included to facilitate servicing.

Nuclear Physics

Introductory Nuclear Physics, by David Halliday, John Wiley & Sons, Inc., New York 16, N. Y. Second edition, 1955. 493 pages. Price $7.50.

Originally issued just five years ago, this book has been revised in order to keep up with the quick developments which are characteristic of this field.

The new chapter on the elements of wave mechanics constitutes an important change. A rearrangement of the remaining chapters has also been effected, both in order and scope, making possible the addition of formula derivations and other modern material at the pertinent spots.

The book remains a balanced account of all the basic points of nuclear physics. The chapter headings as they now stand are: basic nuclear concepts; elements of quantum mechanics; two-nucleon systems; radioactive decay and alpha emission; gamma radiation and internal conversion; beta decay; passage of charged particles and gamma rays through matter; detection of charged particles and photons; neutrons; nuclear masses, mass numbers, and mass abundances; nuclear structure; charged particle accelerators; nuclear reactions; nuclear fission; nuclear spin and magnetism; cosmic rays and subnuclear particles.

Western Reserve Plans Conference

Western Reserve University will be host at a three-day conference on "Practical Utilization of Recorded Knowledge —Present and Future," to be held Jan. 16-18, 1956, on the WRU campus in Cleveland, Ohio.

Emphasis will be on organization and use of printed material in such areas as the sciences, law, patents, military and governmental information, business, industry and education.

Offering the conference will be Western Reserve's School of Library Science and its new Center for Documentation and Communication Research. Dr. Jesse H. Shera is dean of the library school; director and associate director, respectively, of the Center are James W. Perry and Allen Kent. The conference will follow the Jan. 15 dedication of WRU's new $1,600,000 library.

More than 30 experts will be on the three-day program, including:

Russell Ackoff, chief of operations research group, Case Institute of Technology; Norman Ball, interdepartmental committee for scientific research and development, National Science Foundation; Walter Crafts, associate director of research, Electro Metallurgical Co.

Hugh W. Field, vice president, Atlantic Refining Co.; H. R. J. Grosch, manager AGT-Computations, General Electric Co.; Herman H. Henkle, MWSE, librarian, John Crerar Library; Louis Koenig, vice president, Southwest Research Institute.

Complete information on the conference is available from the Dean, School of Library Science, Western Reserve University, Cleveland 6, Ohio.

Index of MIDWEST ENGINEER *Advertisers*

Help the Society help you!

Keep it posted on changes in your status

To make sure we have you listed correctly, if you change your status

MAIL FORM TO THE WESTERN SOCIETY OF ENGINEERS
84 E. Randolph St., Chicago 1, Ill.

Name:.....

Position:.....

Firm:.....

Firm Address:.....

Home Address:.....

Home Phone:..... Business Phone:.....

Engineers' Pay Is Still Higher

Engineers and other professional employees in American industry now are earning about 4.5 per cent more than they earned last year, according to a survey of compensation paid to administrative and technical personnel just completed by the Executive Compensation Service of the American Management Association. The majority of the companies surveyed reported granting salary increases to individuals in this group during the past year.

The study, the second on this subject that the 21,000-member management educational association has conducted, covered 20 engineering and professional job categories in 19 industries. It is part of a continuing series designed to report salary ranges for specific "exempt" (from compulsory overtime penalty pay provisions of the Fair Labor Standards Act) jobs in business and industry. Most of the positions studied are technical or highly specialized in nature; typical are those of development chemist, project engineer (electrical or mechanical), industrial engineer, and sales engineer.

Considering the great demand for and short supply of professional personnel, the range of salaries reported in the survey is surprisingly narrow, the A.M.A. report says. The average beginning engineer receives about $4,500 a year. Median pay for industrial engineering positions is approximately $6,000 annually; for chemical positions, $6,500; for electrical and mechanical engineering, $7,000.

The pay level for these 20 administrative and technical positions is just about the same as that of production foremen, as indicated by a recent A.M.A. survey of foreman compensation. Like foremen and like "middle management" personnel (those between first-line supervision and the policy-making level), individuals in similar professional and administrative positions tend to receive similar salaries regardless of geographic location. In contrast to management compensation, which usually is higher in larger companies, their salaries do not vary significantly among industries or with company size, the study indicates.

Technical and professional employees are less likely to receive bonuses in addition to their salaries than are foremen and middle management personnel. Only a fifth of the individuals included in the new survey received bonuses this year, as compared to a fourth of the foremen and two-fifths of the middle management executives.

Like the other reports of the A.M.A.'s Executive Compensation Service, the administrative and technical positions surveys are designed to help companies evaluate their compensation policies in the light of current practice in other firms.

Uranium Growth Problem Now Solved

One of the most important problems of reactor operation—preventing uranium from growing—has been solved by scientists at Argonne National Laboratory and at other Atomic Energy Commission laboratories.

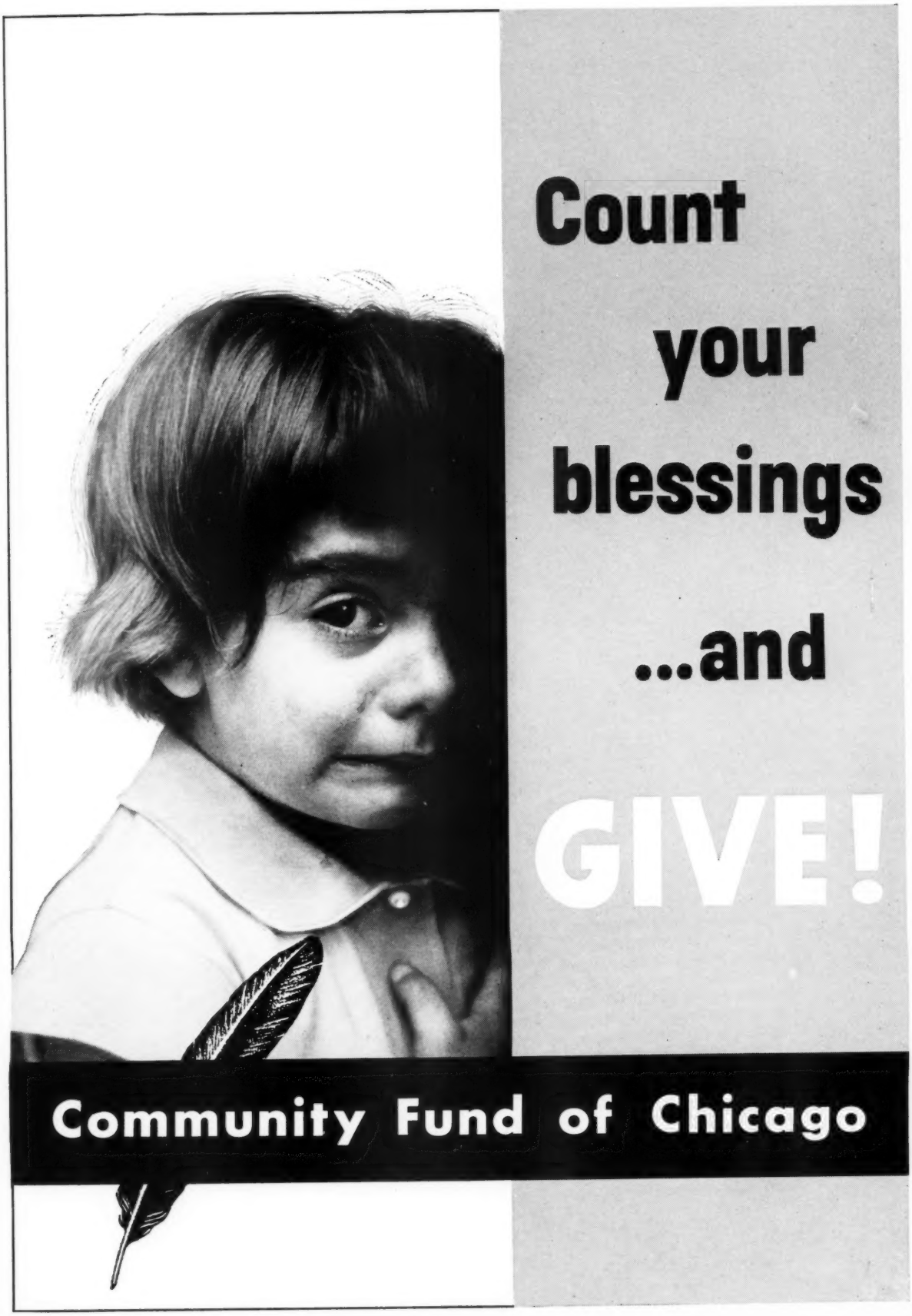
Argonne metallurgists, S. H. Paine and J. H. Kittel, in a paper prepared for the United Nation's International Conference on the Peaceful Uses of Atomic Energy, indicate that the stability of uranium fuel is perhaps the most important practical problem in the operation of nuclear reactors. The authors of the paper entitled "Irradiation Effects in Uranium and Its Alloys" report that it is most important that the shape and size of the reactor core remain unchanged after a period of operation.

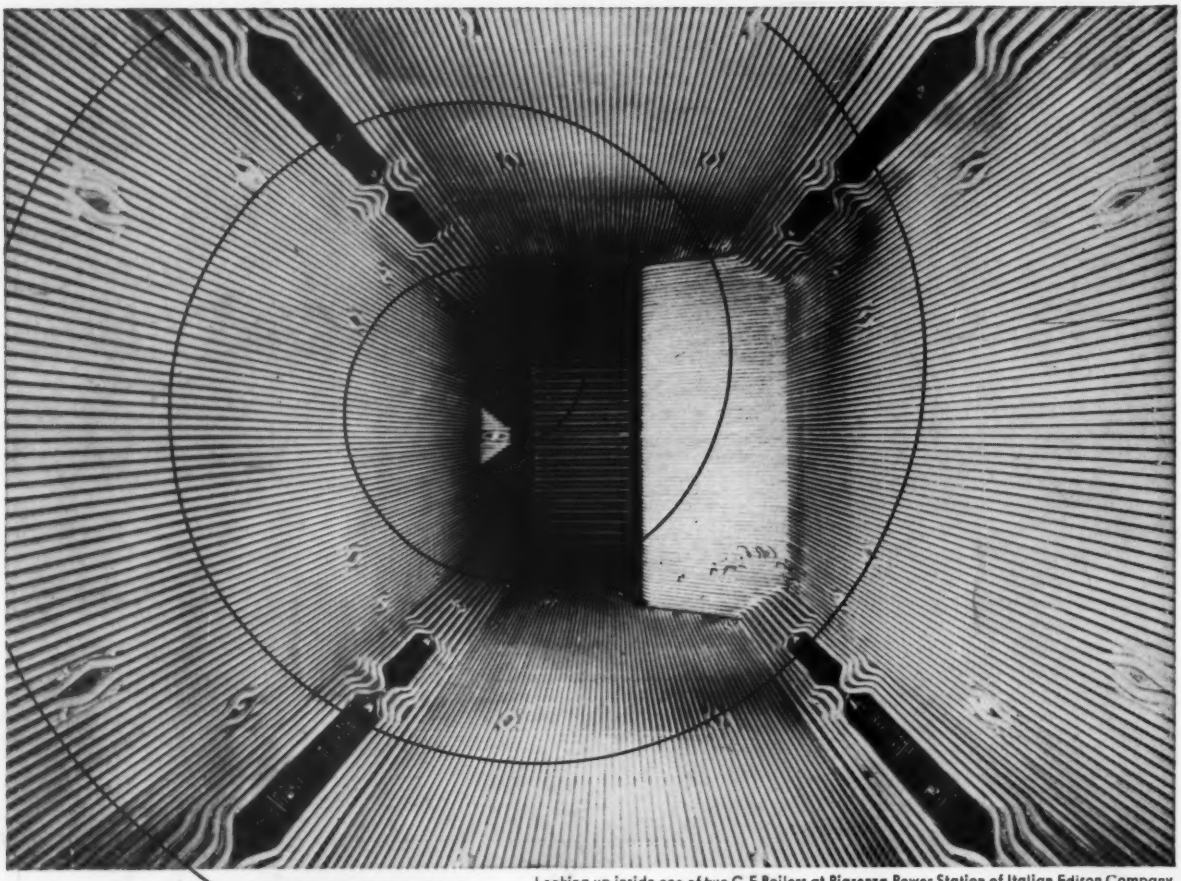
Experience has shown that fuel elements made of uranium lose their shape badly under nuclear bombardment and even under repeated temperature cycles. For example, under some conditions, rods of uranium have been known to more than double their length after a burnup of only one atom in each thousand.

At Argonne National Laboratory and at other U. S. Atomic Energy Commission installations, metallurgists have succeeded in isolating the basic causes of this instability and have learned how to treat the metal so that it is stable under irradiation.

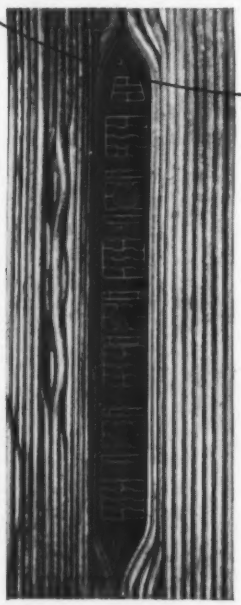
Dimensional changes in uranium are found to be closely related to the methods by which it has been fabricated, the temperatures used in fabrication, and the chemical composition of the metal. For example, castings elongate or grow much less rapidly than most types of rolled uranium. However, rolling of metal has certain advantages as a fabrication method, and it is here that dependence on temperature is most clearly demonstrated. Uranium which has been rolled at temperatures about 300° Centigrade (572° Fahrenheit) has been found to grow in length much more rapidly than that which has been fabricated at higher temperatures. In fact, if a high enough temperature is used, the growth is reversed and the metal is observed to shorten under irradiation.

Normal impurities in uranium do not radically affect its radiation behavior, but additions of certain alloying elements such as silicon, chromium, zirconium, niobium, or molybdenum, can be beneficial. Unalloyed uranium develops a rough surface even when it has been made dimensionally stable. This effect is caused by the large size of the crystals or "grains" which make up the metal. Addition of the alloying elements mentioned above reduces the grain size in the metal, thus improving the surface smoothness.


Count
your
blessings
...and
GIVE!
Community Fund of Chicago



Looking up inside one of two C-E Boilers at Piarenza Power Station of Italian Edison Company



Corner of furnace showing one of four C-E Tilting Burners (Type TV) for firing pulverized coal, oil or gas, separately or in combination.

The camera sees an *Inferno*

That's right! The tiny white spot you see in the center of the picture is a water-cooled window through which a television camera has a bird's eye view of the eight-story-high inferno raging in this C-E Utility Boiler.

A screen in the control room of the power station shows the operator what the camera sees, giving him invaluable information on flame conditions, combustion stability, etc.

For drama in a boiler, there's no better show "on camera" than that put on by those remarkable performers—one in each of the four corners of the furnace—aptly named TV Burners. For these **T**angential **V**ertically adjustable burners—exclusive development of Combustion Engineering—create a literal *cyclone of flame*. The four flame streams—blasting into each other with tremendous impact—result in thorough mixing of fuel and air in the shortest possible time; thus effecting rapid and complete combustion, whether the fuel is pulverized coal, oil or gas.

Furthermore, this inferno moves up and down automatically to maintain the uniform steam temperature so important to peak turbine performance.

While the C-E "TV" Burner is "on stage" only in large power stations, it typifies the many major advances in fuel burning and steam generation pioneered by Combustion. These advances mean top performance in *any* boiler, large or small, that bears the Combustion nameplate.

B-811

COMBUSTION ENGINEERING

Combustion Engineering Building
200 Madison Avenue, New York 16, N.Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS AND FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE